Installation and Verification Manual

HP 8560A Spectrum Analyzer

8508 A

MP MASTER
MA28012

HEWLETT PACKARD

HP Part No. 08560-90061 Microfiche Part No. 08560-90059
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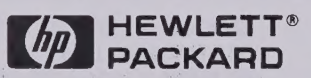
HP 8508A
VECTOR VOLTMETER
(Including Option 001)
Operating and Service Manual



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SOUTH QUEENSFERRY, WEST LOTHIAN, SCOTLAND EH30 9TG.

Manual Part No. 08508-90043

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Declaration of Conformity

according to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	**Hewlett-Packard Ltd.**
Manufacturer's Address:	Queensferry Microwave Division South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

Declares that the product

Product Name:	Vector Voltmeter
Model Numbers:	HP 8508A
Product Options:	This declaration covers all options of the above products as detailed in TCF A-5951-9852-02.

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility.

Against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992

As Detailed in:	Electromagnetic Compatibility (EMC) Technical Construction File (TCF) No. A-5951-9852-02
Assessed by:	DTI Appointed Competent Body EMC Test Centre, GEC-Marconi Avionics Ltd., Maxwell Building, Donibristle Industrial Park, KY11 5LB Scotland, United Kingdom

Technical Report Number:6893/2200/CBR, dated 23 September 1997

Supplementary Information:

The product conforms to the following safety standards:

EN 61010-1(1993) / IEC 1010-1(1990) +A1(1992) +A2(1994)
CSA-C22.2 No. 1010.1-93
EN 60825-1(1994) / IEC 825-1(1993)

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE-marking accordingly.

South Queensferry, Scotland	*31 August 1998*	R M Evans
Location	*Date*	*R.M. Evans / Quality Manager*

Europe Contact:
Your Local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department 2Q / Standards Europe
Herrenberger Strasse 130, D7030 Boblinger (Fax: +49-7031-143143).

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5 Consumables such as paper, disks, magnetic tapes, ribbons, inks, pens, gases, solvents, lamps, filters, fuses, seals, etc.

Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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Statement of Compliance

Electromagnetic Compatibility (EMC) Information

This product has been designed to meet the protection requirements of the European Communities Electromagnetic Compatibility (EMC) directives:

EN55011:1991 (Group 1, Class A)
EN50082-1:1992
- IEC 1000-4-2 (1995) ESD
- IEC 1000-4-3 (1995) Radiated Susceptibility
- IEC 1000-4-4 (1995) EFT

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

Safety Information

This instrument has been designed and tested in accordance with publication EN61010-1(1993) / IEC 1010-1(1990) +A1(1992) +A2(1994) / CSA C22.2 No. 1010.1(1993) Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

WARNING

This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the powercord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

DO NOT operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

DO NOT use repaired fuses or short-circuited fuseholders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.

DO NOT perform procedures involving cover or shield removal unless you are qualified to do-so: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only.

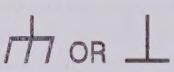
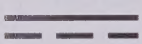
DO NOT service or adjust alone: Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

Safety Symbols

The following symbols on the instrument and in the manual indicate precautions which must be taken to maintain safe operation of the instrument.

Safety Symbols	
	The Instruction Documentation Symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the supplied documentation.
	Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.
	Frame or chassis ground terminal - typically connects to the equipment's metal frame.
	Alternating current (AC)
	Direct current (DC)
	Indicates hazardous voltages
WARNING	Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.
CAUTION	Caution denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.
	The CE mark shows that the product complies with all relevant European Legal Directives.
ISM 1-A	This is a symbol of an Industrial, Scientific, and Medical Group 1 Class A product.
	The CSA mark is a registered trademark of the Canadian Standards Association, and indicates compliance to the standards layed out by them.

Noise Declaration

LpA<70 dB

am Arbeitsplatz (operator position)
normaler Betrieb (normal position)
nach DIN 45635 pt.19 (per ISO 7779)

Operating Environment

This instrument is designed for Indoor use only.

The instrument may be operated at temperatures from 0°C to +55°C at altitudes up to 4600 m (15,000 ft.). The instrument may be operated in environments up to 95% relative humidity to 40°C, but it should be protected from temperature extremes which may cause condensation.

CAUTION

This instrument is designed for use in Installation Category II and Pollution Degree 2 per IEC1010 and 644 respectively.

Cleaning

To clean the instrument: Use a soft, clean damp cloth to clean the front-panel and side covers.

CAUTION

Mains supply voltage fluctuations should not exceed ±10% of the nominal selected line voltage.

CAUTION

Before switching on this instrument, make sure that the line voltage slide switch is set to the voltage of the power supply, and the correct fuse is installed. Ensure the power supply voltage is in the specified range.

WARNING

Appliance coupler (mains input powercord) is the power disconnect device. Do not position the instrument such that access to the coupler is impaired.

WARNING

For continued protection against fire hazard, replace the line fuse only with the same type and line rating (T1.25 A 250 V @ 100 / 120 V; T0.75 A 250 V @ 220 / 240 V). The use of other fuses or materials is prohibited.

WARNING

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition only (in which all means for protection are intact).

WARNING

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

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Figure 1-1. The HP 8508A Vector Voltmeter

General Information Section 1

1-1 INTRODUCTION

This service manual contains information required to install, test, adjust and service the Hewlett-Packard Model 8508A Vector Voltmeter. The HP 8508A is shown in Figure 1-1.

1-2 SPECIFICATIONS

Instrument specifications are listed in Table 1-2 of the Probe Module Insert. These specifications are the performance standards or limits against which the instrument is tested. The Probe Module Insert document contains the specifications relevant when the Probe Module is inserted into the HP 8508A Vector Voltmeter mainframe.

1-3 SAFETY CONSIDERATIONS

This instrument is a Safety Class 1 instrument (provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings and instructions before operation. The ***WARNINGS*** indicate the possibility of personal danger and ***CAUTIONS*** indicate the possibility of instrument damage.

1-4 INSTRUMENT IDENTIFICATION

Attached to the instrument is a serial number plate. The serial number is in the form XXXXUXXXXX. The first four digits and the letter comprise the serial prefix, which is the same for all identical instruments. The serial prefix only changes when a change is made to the instrument. The last five digits comprise the serial number, which is unique to each instrument.

To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified by the manual print date and part number (both of which appear on the manual title page). Complimentary copies of the supplement are available from Hewlett-Packard.

1-5 DESCRIPTION

The HP 8508A Vector Voltmeter is a dual-channel, autoranging receiver which measures the voltages of two CW signals and the phase difference between them. The following diagram shows the vector relationship between two signals at the same frequency and the way that one is used as a phase reference in the HP 8508A.

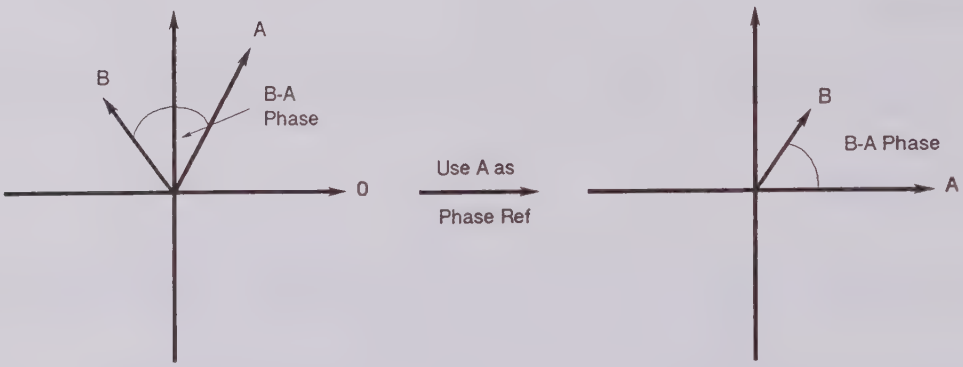


Figure 1-1. Vector Signals

The measurements are either of a single channel or the ratio between the two channels, and results displayed as voltage or power (in linear or log units), normalized magnitude and phase angle, or real and imaginary components. In addition the HP 8508A has built-in procedures for simple network analysis. The HP 8508A has two configurations - the first providing two high impedance probe inputs with a frequency range from 100kHz to 1GHz, and the second providing two 50 ohm type-N connector inputs with a frequency range of 300kHz to 2GHz. The configuration can be changed by replacing the instrument's input module.

The HP 8508A can be used in applications where vector signal information is required at low cost - particularly in the design, manufacture or service of RF assemblies. The HP 8508A is a simple, high-sensitivity, receiver and can be used with any source, including one that is part of the device to be tested. Its built-in HP-IB interface for programming allows it to be used as an economical tool in automated production environments.

Typical measurements include voltage, power, gain or loss, impedance and phase matching. Measurements can be made either from the input to the output of the device, or by probing within the device. Other measurements include transmission and reflection - procedures that include test system calibration against known standards.

A typical setup includes a source (which may be part of the device to be tested), a reference path and a measurement path. Cables, adapters and other accessories required depend on the application. The following diagram shows an example setup.

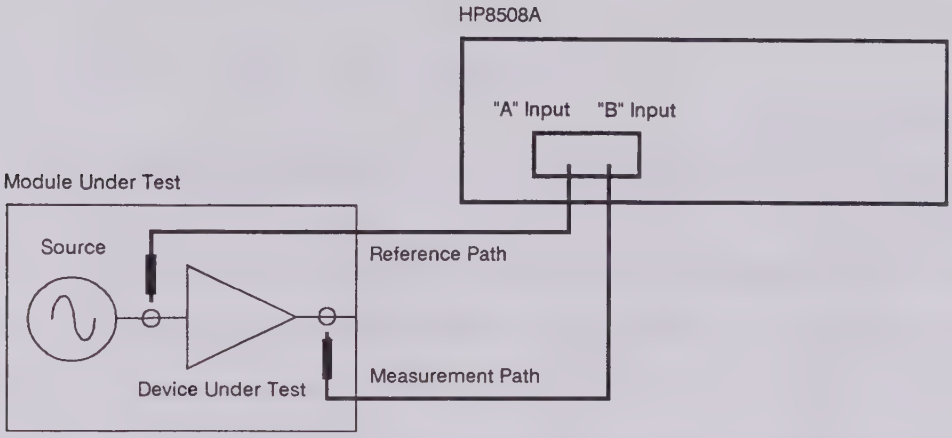


Figure 1-2. Typical Probing Set-up

In order for the source to be suitable for use with the HP 8508A, it has to meet certain specifications. It must produce a stable CW signal at the frequency of interest, with no modulation.

1-6 OPTIONS

The standard instrument is supplied with front handles (HP Part Number 5062-3989) while rack mounting flanges or bail carrying handle and front cover are available as options.

Mechanical Options

Bail Handle Option 001. Adds bail carrying handle, rugged feet and front panel storage cover.

Rack Flange Kit Option 908. (HP Part Number 5062-3977). This kit contains all necessary hardware and installation instructions for mounting the Vector Voltmeter (not fitted with front panel handles) in a rack with 482.5 millimeter (standard 19 inch) spacing.

Rack Flange Kit Option 913. (HP Part Number 5061-4071). This kit contains all necessary hardware and installation instructions for mounting a Vector Voltmeter, with front panel handles, in a rack with 482.5 millimeter (standard 19 inch) spacing.

Instrument Options

Option 050. Provides an HP Model 85082 50 ohm Input Module instead of the HP Model 85081 High Impedance Input Module.

Option 100. Deletes Input Module.

Documentation Options

Extra Manual Set Option 910. Provides an additional copy of the Operating and Service Manual and the User's Guide (English version).

Japanese User's Guide Option 030. Substitutes the Japanese version of the User's Guide for the English version.

French User's Guide Option 031. Substitutes the French version of the User's Guide for the English version.

German User's Guide Option 032. Substitutes the German version of the User's Guide for the English version.

Italian User's Guide Option 033. Substitutes the Italian version of the User's Guide for the English version.

Spanish User's Guide Option 034. Substitutes the Spanish version of the User's Guide for the English version.

Support Option

Extended Hardware Support Option W30. Provides an additional 2 years of return-to-HP hardware service support.

1-7 ACCESSORIES SUPPLIED

The accessories supplied with the instrument are:

* Front Handle Kit with standard instrument.
* An appropriate power cable (see Section 2).
* An Operating and Service Manual
* A User's Guide
* Accessory kit

comprising:	Accessory Kit Box	1	1540-0149
	Square Plastic Box	1	1540-0034
	Probe Tip	6	5020-0457
	Probe Tip Nut Driver	1	8710-0084
	Pre-cut Foam Insert	1	9220-3728
	Probe Tip/BNC Adaptors	2	HP 10218A

1-8 EQUIPMENT AVAILABLE FOR USE WITH THE HP 8508A

A printer and controller can be used with this instrument.

1-9 RECOMMENDED TEST EQUIPMENT

Table 1-1 lists the test equipment required for testing, adjusting and servicing the Vector Voltmeter. The Critical Specifications column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds the critical specifications.

Table 1-1. Recommended Test Equipment

Instrument	Critical Specification	Recommended Model	Use*
Synthesized Signal Generator	Frequency Range 100kHz to 2000MHz Output Level -60dBm to +20dBm	HP 8642B	P, A, O
Power Divider	dc to 18GHz, 50ohm, Insertion Loss 6dB, Tracking <0.4dB	HP 11636A	P, A, O
DVM	Sensitivity 1mV Range to 1.0V	HP 3456A	A
AC Calibrator	Frequency Output of 20kHz Output Level 100mV ±20uV	Datron 4200A	A
50 ohm Termination	50 ohm, Type-N (m), SWR <1.01	HP 909A Opt 012	P, A, O
Dual Channel Synthesizer	Frequency Range 0 to 13MHz Output Level -10dBm to +19dBm Phase Offset ±175 deg Independent adjustment on both channels for both magnitude and phase.	HP 3326A	P
Attenuator	0 - 110dB in 10dB steps Calibration Certificate required.	HP 8496A/G Opt 890	P
Attenuator Driver	Required for HP 8496G	HP 11713A	P
RF Power Meter	100kHz to 4.2GHz (with Power Sensor) 1mW Reference Output NBS Traceable	HP 436A or HP 438A	A, P
Power Sensor	50 ohm, 100kHz to 4.2GHz SWR 1.2, 1uW to 100mW	HP 8482A	A
Oscilloscope	Bandwidth 50MHz Sensitivity 1mV/div Sweep Speed 0.2us/div	HP 54200A	A
Accessory Kit		HP 11570A	P, A, O
Input Module Extender		HP 08508-60032	A, T, O

* P = Performance, A = Adjustment, T = Troubleshooting, O = Operation

NOTE: The HP 8496A/G attenuator should be calibrated within 0.03dB for the 10dB through 60dB steps.

Installation Section 2

2-1 INTRODUCTION

This section provides installation instructions for the Hewlett-Packard Model 8508A Vector Voltmeter and its accessories. This section also includes information about initial inspection and damage claims, preparation for use, packaging, storage and shipment.

2-2 INITIAL INSPECTION

WARNING

IF THERE IS ANY SIGN OF SHIPPING DAMAGE TO THE INSTRUMENT, DO NOT APPLY POWER. RETURN THE INSTRUMENT TO THE NEAREST HEWLETT-PACKARD OFFICE FOR CHECKING.

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The Performance Tests check the complete specification of the instrument.

If the contents of the shipment are incomplete, if there is mechanical damage or defect, or if the instrument performance fails to meet specification, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement at Hewlett-Packard's option without waiting for a claims settlement, providing that Hewlett-Packard and/or the carrier are notified within 12 days of shipment.

2-2 PREPARATION FOR USE

WARNING

TO AVOID THE POSSIBILITY OF INJURY OR DEATH, THE FOLLOWING PRECAUTIONS MUST BE FOLLOWED BEFORE THE INSTRUMENT IS SWITCHED ON.

(A) NOTE THAT THE PROTECTION PROVIDED BY GROUNDING THE INSTRUMENT CABINET MAY BE LOST IF ANY POWER CABLE OTHER THAN THE THREE-PRONGED TYPE SUPPLIED IS USED TO COUPLE THE AC LINE VOLTAGE TO THE INSTRUMENT.

(B) IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER TO REDUCE OR INCREASE THE LINE VOLTAGE, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

(C) THE POWER CABLE PLUG SHALL ONLY BE INSERTED INTO A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

2-4 POWER REQUIREMENTS

Operating Voltage Range: 100/120/220/240 V

Operating Frequency Range: 47-440 Hz

Power Dissipation: 45 VA (max).

2-5 LINE VOLTAGE SELECTION AND FUSE

The line voltage is selected by the rear panel switch.

CAUTION

Before connecting the instrument to a power outlet ensure that the line voltage selector is correctly set, and that a fuse of the correct rating is fitted.

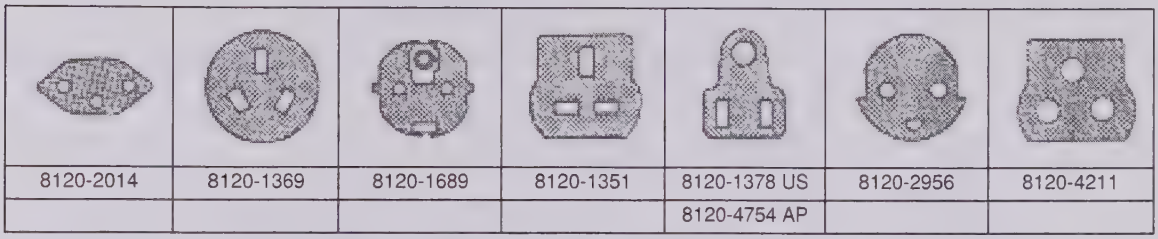
Fuse ratings are given in the table below:

Table 2-1. Fuse Ratings

Nominal Line	Fuse Rating	HP Part Number
100/200 V	T1.25 A / 250 V	2110-0305
220/240 V	T0.75 A / 250 V	2110-0360

2-6 POWER CABLE

The instrument is equipped with a three-wire power cable. When connected to a power outlet, this cable grounds the instrument case. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2-1 for part numbers of the power cable and plug configurations available. The number shown below each plug is the Hewlett-Packard part number of a power cord equipped with that plug. If the appropriate power cord is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service Office and a replacement will be provided.



8120-2014	8120-1369	8120-1689	8120-1351	8120-1378 US	8120-2956	8120-4211
				8120-4754 AP		

Figure 2-1. Plug Configurations

The color code used in each over cable is given below:

Table 2-2. Color Codes

Line:	Brown
Neutral:	Blue
Ground:	Green/Yellow

2-7 OPERATING ENVIRONMENT

Operating Temperature: 0 to 55°C

Humidity: Up to 95% relative humidity to 40°C

Altitude: The instrument may be operated at altitudes up to 4600 m (15000 ft).

2-8 MATING CONNECTORS

Table 2-3 lists the connectors which mate with the instrument ports.

Table 2-3. Mating Connectors

Connector	Type	Mating Connector Part Number
PROBE POWER	(m)	5060-0466
TEST OUT	BNC (f)	1250-1448
OUTPUT 1	BNC (f)	1250-0448
OUTPUT 2	BNC (f)	1250-0448
HP-IB	(f)	see Table 2-4

2-9 RACK MOUNTING

Figure 2-2 illustrates the Rack Mount Kits available for use with the HP 8508A.

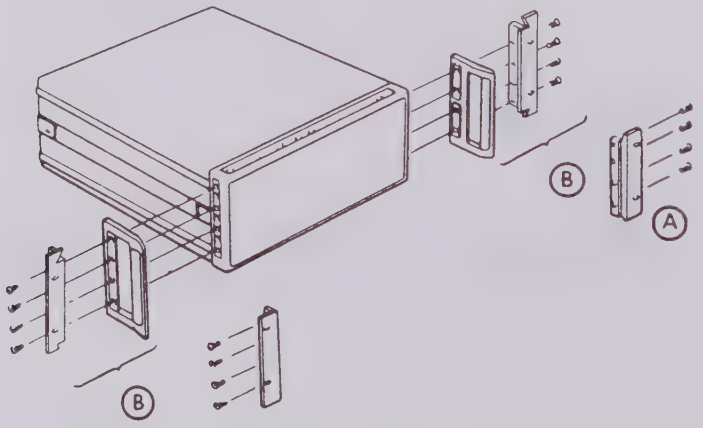


Figure 2-2. Rack Mount Kits

2-10 HEWLETT-PACKARD INTERFACE BUS (HP-IB)

This section contains information for installing the HP 8508A Vector Voltmeter into a Hewlett-Packard Interface Bus (HP-IB) system.

The HP-IB is Hewlett-Packard's implementation of IEEE Standard 488-1978 (Digital Interface for Programmable Instrumentation). This standard defines a physical interface and protocol which enables the remote control of instrumentation systems.

2-11 HP-IB CONNECTOR

Logic Levels

The HP-IB logic levels are TTL compatible i.e. the true (1) state is 0 to +0.5V DC and the false (0) state is +2.5 to +5V DC.

Mating Connector

HP 1251-0293;
Amphenol 57-302040

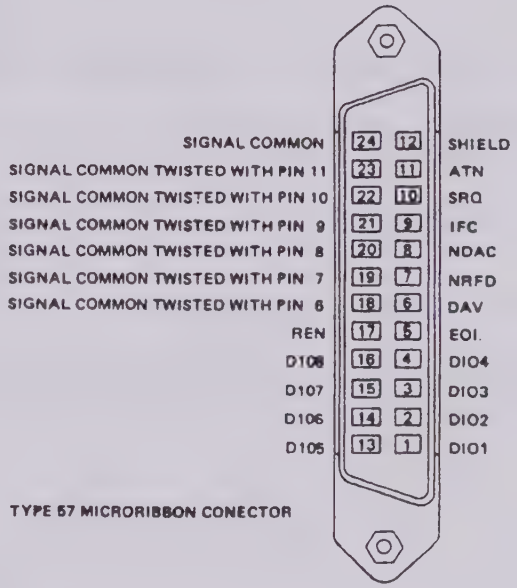


Figure 2-3. HP-IB (rear panel) Connector

The HP-IB connector on the rear panel of the HP 8508A provides the physical interface to connect the HP 8508A into an HP-IB system. Figure 2-3 illustrates the connector pin configuration. Devices in the HP-IB system may be interconnected in any suitable arrangement (star, delta, etc) using the HP-IB cables listed in Table 2-4. However, the cable length restrictions should be observed.

2-12 HP-IB CABLES

Table 2-4 lists the HP-IB cables available:

Table 2-4. HP-IB Interface Cables

HP Part Numbers	Cable Lengths
HP 10833A	1m (3.3ft)
HP 10833B	2m (6.6ft)
HP 10833C	3m (13.2ft)
HP 10833D	0.5m (1.6ft)

To achieve design performance restrictions are placed on the length of the HP-IB system cable as follows:

1. The total length of HP-IB cable use to interconnect devices on the HP-IB must not exceed 2 meters (6 feet) times the number of devices in the system

2. The total length of HP-IB cable used to interconnect all devices must not exceed 20 meters (65 feet).

2-13 HP-IB ADDRESS SELECTION

The HP-IB address is selected via the front panel. Press [SHIFT] [VIEW ADDRESS] and use the arrow keys to scroll to the desired number.

Table 2-5. HP-IB Address Codes

Address	Address Characters	
Decimal	Talk	Listen
0	@	SP
1	A	!
2	B	"
3	C	#
4	D	$
5	E	%
6	F	&
7	G	'
8	H	(
9	I	)
10	J	*
11	K	+
12	L	,
13	M	-
14	N	.
15	O	/
16	P	0
17	Q	!
18	R	2
19	S	3
20	T	4
21	U	5
22	V	6
23	W	7
24	X	8
25	Y	9
26	Z	:
27	[	;
28	\	<
29	]	=
30	Ø	>

2-14 STORAGE AND SHIPMENT

Environment

The instrument may be stored or shipped in environments within the following limits:

Temperature: -40° Centigrade to +75° Centigrade.
Humidity: up to 90% at 65° Centigrade.
Altitude: 15300m (50000ft).

The instrument should also be protected from temperature extremes which may cause condensation inside it.

Packaging

Tagging for Service: If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the front of this manual and attach it to the instrument.

Original Packaging: Containers and material identical to those used in the factory packing are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, model number and full serial number. Also mark the container "FRAGILE" to ensure careful handling.

Other Packaging: The following general instructions should be used for re-packaging with commercially available materials.

(a) Wrap the instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service centre, attach a tag indicating the type of service required, return address, model number and full serial number.)

(b) Use a strong shipping container. A double-walled carton of 350-pound test material is adequate.

(c) Use a layer of shock absorbing material 70mm to 100mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the control panel with cardboard.

(d) Securely seal the shipping container.

(e) Mark the shipping container "FRAGILE" to ensure careful handling.

(f) In any correspondence, refer to the instrument by model number and full serial number.

Operation Section 3

3-1 GETTING STARTED

3-2 INTRODUCTION

This section provides complete operating information for the Vector Voltmeter. The items covered include:

* detailed descriptions of each front and rear panel key, connector, switch and display
* general and detailed operating instructions
* information on remote operation

3-3 OPERATOR'S MAINTENANCE

The only maintenance you as an operator should normally perform is replacement of the primary power fuse. Fuses may be ordered under HP Part Number 2110-0305 (T1.25A/250V) for 100/120Vac operation or under HP Part Number 2110-0360 (T0.75A/250V) for 220/240Vac operation.

Fault finding in the HP 8508A is aided by the self-test routine which is run whenever the instrument power is switched on. This routine checks the assemblies in the HP 8508A Vector Voltmeter. When the self test routine is initiated, the current firmware revision will be shown in Display 2 for a few seconds. Display 1 will then show 'tSt' while Display 2 shows a 3-digit number appropriate to the assembly being tested. The entire test routine takes approximately 8 seconds to complete. If one or more faults exist, the self test routine will halt at the first fault and display the appropriate error number. In this situation, refer to Section 8 (Troubleshooting) in this manual.

You can perform an automatic calibration sequence by pressing [SHIFT] [CAL TEST].

All other maintenance should be referred to qualified service personnel.

3-4 NEW USER INTRODUCTION

WARNING

Before the Vector Voltmeter is switched on, all protective earth terminals, extension cords, autotransformers and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

For continued protection against fire hazard, replace the line fuse with only a 250V fuse of the same rating. Do not use repaired fuses or short-circuited fuse holders.

CAUTION

Before the Vector Voltmeter is switched on, it must be set to the same line voltage as the power source or damage to the instrument may result.

Don't zap your input probes!

The probes of the HP 8508A are susceptible to damage from electro-static discharge (ESD). Comply with the following precautions to help avoid damage to your probes.

Anti-static precautions

Never touch the tip of the probe.

Eliminate ESD on the body by wearing a snug-fitting ground strap that is connected to earth ground through a 1M ohm resistor.

Eliminate ESD on the work surface by using a grounded anti-static bench mat. Optional floor mats provide an extra measure of protection especially in areas with floor carpet. Never use this product on a carpeted work surface unless the carpet is of a conductive type specifically designed to eliminate ESD.

Do not introduce ESD into the Device Under Test (DUT) while using the probes. If an unprotected person touches a part of the DUT, a static surge could damage the DUT as well as the probes.

Always refit the protective cover when the probe is not in use.

Mechanical abuse

The tips of the probes are fragile and can break if the probe is dropped.

3-5 FRONT PANEL FEATURES

Figure 3-1. Front Panel

MEASUREMENT KEYS

Introduction
The following four keys operate similarly. One press lights the LED and the measurement result is shown in the appropriate display window. A second press turns off the LED and the measurement result. Any single measurement is available and any combination can be chosen by selecting the required measurements. Note that A, B/A mag and B, B-A phase combinations can be selected using shifted functions (that is, pressing [SHIFT] and the appropriate key). If a new measurement is selected which uses the same display as an existing measurement, the existing measurement will be turned off (for example, selecting Phase when B is displayed will turn B off).

A
Measures the amplitude of A. Default is mV on Display 1, changeable to dBuV by toggling the [DISPLAY] key to dB. Power can be displayed by pressing the [POWER MEAS] key and selecting either 50 or 75 ohms with the [SYSTEM IMPD] key. Units available are uW and dBm.

B
Operates in the same way as A but the value appears on Display 2, units are controlled by the [DISPLAY] key.

B/A mag
Measures the B/A ratio. Default is linear units on Display 1, changeable to dB using the [DISPLAY] key.

B-A phase
Measures the phase of B with respect to A, in degrees.

A, B/A mag
Places the A measurement in Display 1 and the B/A measurement in Display 2.

B, B-A phase
Places the B measurement in Display 1 and the B-A phase in Display 2.

DISPLAY
Defines the scale associated with the display(s), depending on what measurement is displayed. Units selects the linear scale and dB selects the log scale.

Example 1 - Amplitude of A has a units scale in mV and a dB scale in dbuV.

Example 2 - Power in A has a units scale in uW and a dB scale in dBm.

FUNCTION KEYS

REF
Works in A amplitude, B amplitude B/A magnitude and Phase to make measurements relative to a set of reference values. [SHIFT] [SAVE REF] stores the current A, B and Phase values, and turns [REF] on. When [REF] is turned on:

displayed phase = measured phase - saved phase and displayed

$$\text{amplitude or magnitude} = \frac{\text{measured amp. or mag.}}{\text{saved amp. or mag.}}$$

REFL MEAS
Uses measurements of B/A ratio and B-A phase to make simple reflection measurements - using an external device. The [SHORT] and [OPEN] reference impedances are used with a bridge or directional coupler and [LOAD] is used when making measurements with a Tee. Note that [LOAD] is selected as a shifted function.

To initialize the measurement, connect the external equipment and connect the appropriate reference impedance to the test port . Press [SHIFT] [SAVE REF]. The REF LED is automatically turned on. The A, B and phase values are then retained and used as a correction for any level and/or phase changes occurring between the A channel (incident) signal and the B channel (reflected) signal.

To make a corrected measurement, connect the DUT to the test port. It is also possible to make an uncorrected measurement by turning REF off.

When making Z or 1/Z measurements, absolute values can be displayed by choosing the appropriate [SYSTEM IMPD] of 50 or 75 ohms. If values normalized to Z0 are required, choose [NORM].

POWER MEAS
Works with A and B amplitude only to convert the measured voltage to an equivalent power using the value selected by the [SYSTEM IMPD] key.

FORMAT
The default display configuration for magnitude and phase related measurements is magnitude in Display 1 and phase in Display 2. An alternative real and imaginary format is available when displaying the following: B/A and Phase (together), rho and phase angle, Z and 1/Z.

DELAY
Uses the B-A phase to make simple delay measurements. The delay is calculated assuming a 4kHz change between the two frequencies. The delay is shown in Display 1 with Display 2 showing "dely" (for delay). The delay can be zeroed by pressing [SAVE REF].

INSTRUMENT STATE

PRESET
This key forces the instrument into a defined measurement state, as follows: A is displayed in mV with no other functions engaged and all ranging is automatic.

Error numbers showing in the display after self-test routine indicate possible instrument failure. Press [PRESET] again. If the error number remains, refer to the Service section information.

NOTE: Err 601 indicates that the Input Module is not correctly installed.

LOCAL
Returns the instrument to front panel control unless local lockout has been asserted over the HP-IB.

ADDRESS
Used to show the current HP-IB address of the instrument. It is changed by using the [STEP] keys. The display reverts to measurement display when another key is pressed.

DISPLAY AREA KEYS

MAG RANGE
When [MNL] is selected, the display resolution is controllable using the [STEP] keys, which move the position of the decimal point. When A and B are displayed together, both displays show the same resolution.

DIR ANLG OUT
When this mode is engaged, the raw phase and magnitude detector outputs are fed directly to the rear panel so that external measurements can be made when a CW or swept(*) source is used. Internal gain ranging is forced into manual operation with the display showing XXX mV full-scale deflection, adjustable by use of the [STEP] keys. The [LOCK RANGE] is also forced into manual mode. The only valid measurement selection is A or B.

(*) The HP 8508A will lose lock if the sweep rate exceeds approximately 15MHz/second or if the frequency reaches a lock range boundary.

LOCK RANGE
When [MNL] is selected, the instrument is prevented from signal searching outside the current frequency range.

RANGE
Display the current lock range, the range can then be changed by using the [STEP] keys. The display reverts to measurement display when another key is pressed.

HOLD VALUE
This retains the displayed values when the signal voltage crosses a fixed threshold or if the instrument loses lock. If both displays are active, the function is associated with the B signal level. If only the A voltage is displayed (Channel B is unused), the function is associated with the A channel. When the function is engaged, the LED beside the key flashes to show that a reading is being held.

CAL TEST
When [CAL TEST] is selected, the instrument performs its power-on self-checks and an internal calibration cycle. If an error number is displayed, or if the HP 8508A continues to display a 'tSt' message, refer to the Troubleshooting section in Section 8 (Service).

METER SELECT
This key is used to associate the METER with either Display 1 or Display 2, or to turn it off. If phase is being displayed in Display 2, a HI or LO annunciator lights to show the meter range.

PROBE POWER
This output provides ±12V supplies, which is sufficient to drive an HP 85024A High Frequency Probe.

TEST OUT
This output provides a signal at approximately 1.6MHz and 150mV to allow the user to check that the HP 8508A Vector Voltmeter is operating. The signal is controlled by the [SHIFT] [CAL TEST] function. The LED beside the connector is on when the test output is enabled.

3-6 REAR PANEL FEATURES

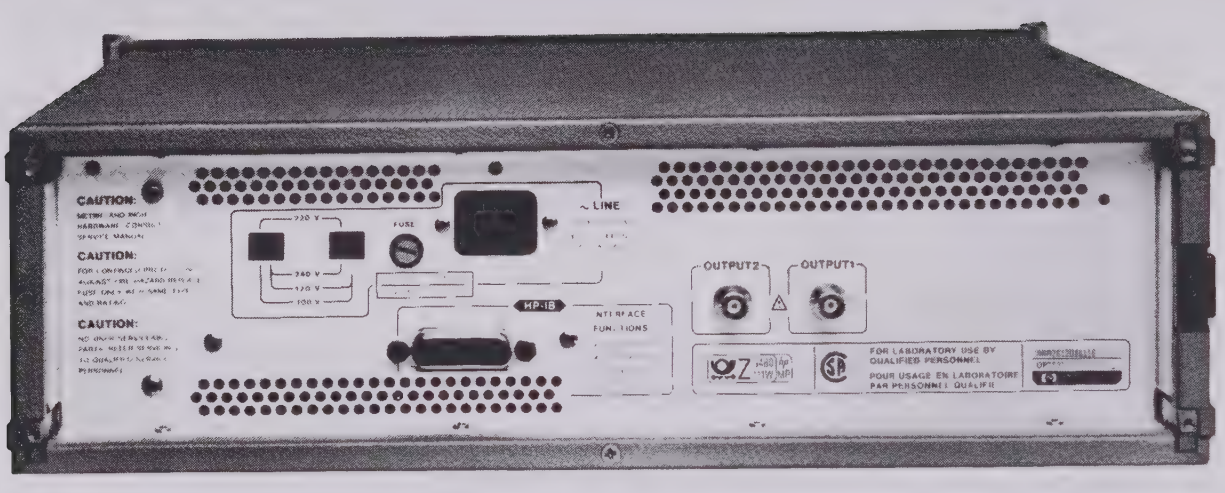


Figure 3-2. Rear Panel

The Rear Panel Outputs provide dc signals which can be fed to external measuring equipment. There are two distinct modes of operation for these outputs.

Normal Mode
This mode provides an analog representation of the digital display values, including internal instrument correction factors. OUTPUT 1 corresponds to DISPLAY 1 and OUTPUT 2 corresponds to DISPLAY2. The update rate is the same as the display update rate (approximately 3 readings per second). The sensitivity is 1mV per displayed digit.

A display value of 123.4mV will produce a d.c. output of 1234mV.
A display value of -135.7 degrees will produce a dc output of -1357mV.

If the MAG RANGE key is used to change the display resolution, the rear panel outputs will change with the display values.

A typical use of this mode might be to drive a chart recorder or similar logging instrument.

Direct Analog Output Mode
This mode provides continuous direct output signals from the internal magnitude and phase detectors through 800Hz low-pass filters. Only limited internal instrument correction factors are applied to the output signals. OUTPUT 1 corresponds to either A or B magnitude (in mV) whichever is selected on the front panel. OUTPUT 2 corresponds to B-A phase. The full scale deflection (FSD) chosen on the front panel always produces an output of 1 volt and this defines the OUTPUT 1 sensitivity .

A display FSD of 1000mV will produce an output of 1000mV for an input of 1000mV.
A display FSD of 31.6mV will produce an output of 1000mV for an input of 31.6mV.

The OUTPUT 2 sensitivity is fixed at 1mV per 0.1 degrees.

A typical use of this mode might be to make narrowband swept measurements on crystals.

3-7 MAKING MEASUREMENTS

3-8 BASIC MEASUREMENTS

Introduction

There are two types of Input Module that can be used with the HP 8508A Vector Voltmeter mainframe. These Input Modules are the HP 85081 High Impedance Input Module and the HP 85082 50 ohm Input Module.

The HP 85081 High Impedance Input Module has a frequency range from 100kHz to 1GHz. This Input Module has high-impedance probes which can be used either alone or with accessories to make in-circuit measurements. The following accessories are available: HP 11570A Accessory Kit (50 ohm accessories), HP 10216A Isolator (probing accessory), HP 115776A 10:1 Divider (probing accessory).

The HP 85082 50 ohm Input Module has a frequency range from 300kHz to 2GHz. This Input Module has 50 ohm type-N connectors. Using the HP 85082 gives you a higher frequency range than the HP 85081 for measurements in a 50 ohm environment.

Getting acquainted with the Vector Voltmeter

To introduce you to the main functions of the HP 8508A, here are a few simple measurements you can try. You will learn to make single channel voltage and power measurements, and measure the vector ratio between two voltages.

a. Measurements with probes

For this section, measurements are made on a printed circuit board buffer amplifier. It is part of a 50MHz source assembly, and has a gain of approximately 14dB.

Probing at the input of the amplifier (the output of the oscillator) gives a reference signal and probing at the output of the amplifier will give the amplifier gain. Use the integral source as the stimulus, so the amplifier will be tested under normal operating conditions.

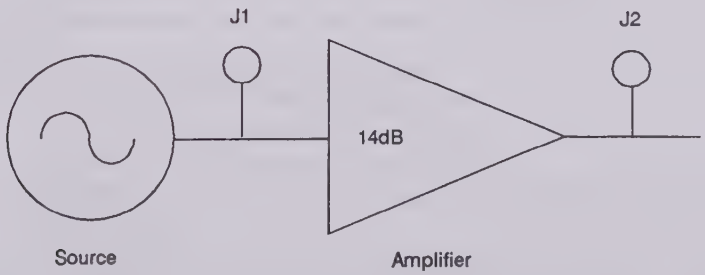


Figure 3-3. Test Assembly With Measurement Points

Since the circuit impedance is 50 ohms, and the measurements are at relatively low frequencies, we can neglect the loading effects of the probe tips on the circuit response. For more sensitive applications, the HP 11576A 10:1 Divider or HP 10216A Isolator accessories can be used with the probes to minimize loading effects and measurement errors.

Measurement details

1. Connect both probes at point "J1" (the amplifier input) in the circuit. Press [PRESET] to return the HP 8508A to a known starting state.

2. Check that the circuit under test is powered up and that the HP 8508A A UNLOCKED indicator is off. Press [B/A MAG] and [B-A PHASE] to display vector ratio.

3. Select [DISPLAY] **dB** to measure the amplifier's gain as a log ratio. Press [SHIFT] then [SAVE REF] to store the reference and set the ratio displays to magnitude 0.0dB and phase 0 degrees.

4. Move the B probe to point "J2" (the amplifier output) and measure the gain and phase change. Change the frequency of the oscillator over its operating range and check the frequency response variation. In a circuit with adjustable gain, the HP 8508A METER display is an aid to tuning. (Use of the meter display is covered in the next example.)

Any unmodulated RF signal in the frequency range 100kHz to 1GHz can be used as a source for these measurements. This includes a source that is part of a larger device under test.

This diagram shows all the keys you will need to make the measurements.

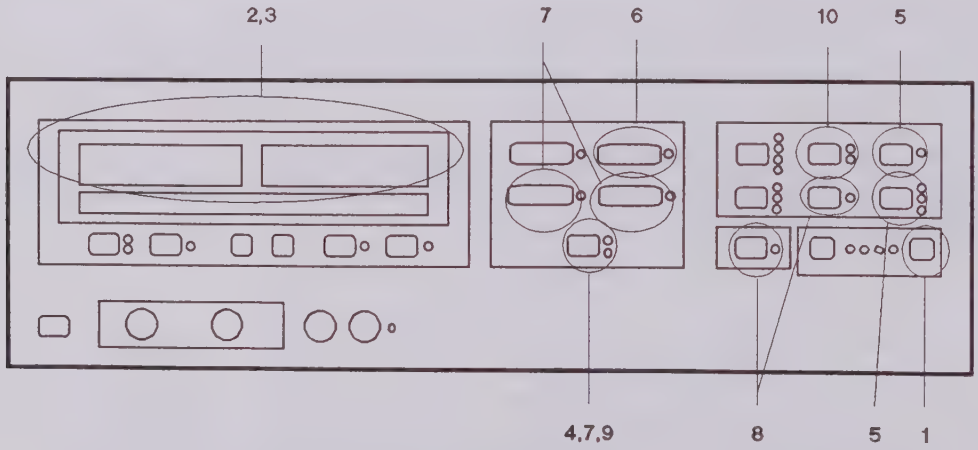


Figure 3-4. Front Panel Keys

In the descriptions throughout this section, keys on the instrument are described by writing the key name in square brackets, for example [PRESET].

Keys that have multiple selections are described by writing "select", followed by the key name in square brackets, then the required function in **bold** type, for example "Select [REFL MEAS] **SWR**". When you press this type of key, the next valid state will be selected. Press the key the required number of times to light the LED beside the state requested. Some selections are only available in combination with other keys, so don't worry if all the selections are not available.

Where a function is accessed using the alternative function of a key, the function is described by showing [SHIFT] then the function name (which appears in blue on the front panel) - for example, to obtain [SHIFT REF] this would be described as press [SHIFT] then [SAVE REF].

1. PRESET

Before beginning a new measurement, press [PRESET] to return the HP 8508A to a known state. The following list shows the preset condition:

MEASUREMENTS

MEASUREMENTS A . . . . . .ON
DISPLAY 1 . . . . . .UNITS

DISPLAYS

METER SELECT . . . . .OFF
LOCK RANGE . . . . . AUTO
MAG RANGE . . . . . AUTO
HOLD VALUE . . . . . .OFF
DISPLAY 1 . . . . . mV
DISPLAY 2 . . . . . blank

FUNCTIONS

REF . . . . . OFF
FORMAT . . . . . OFF
REFL MEAS. . . . . OFF
REF SELECT . . . . . OFF
POWER MEAS. . . . . .OFF
SYSTEM IMPD . . . . . .OFF

2. UNLOCKED INDICATOR

Check that there is no input to the probes. With no input signal, the A UNLOCKED indicator should be ON and DISPLAY 1 (the left display) should indicate under-range (--.-).

NOTE: If there are high level radiated signals present, DISPLAY 1 may give a reading. This reading is caused by the un-terminated probe acting as an antenna. It will not affect the instrument's ability to make measurements on your circuit.

3. SINGLE-CHANNEL MEASUREMENT - CHANNEL A

The A probe is used as a reference by the HP 8508A, and must be connected for the instrument to function. The signal level should be in the range 300uV to 1V.

Connect the A probe to the source and turn on the output. The A UNLOCKED indicator should go OFF and DISPLAY 1 should show the source output voltage.

4. VOLTAGE UNITS

Select [DISPLAY] **dB** to have the HP 8508A compute and display the voltage in dBuV.

5. POWER MEASUREMENT

Press [POWER MEAS] to display power in dBm in a 50ohm system. The conversion of voltage to power uses the value set with the [SYSTEM IMPD] key, the default value being 50 ohms.

Press [POWER MEAS] again to return to the voltage measurement mode.

6. SINGLE-CHANNEL MEASUREMENT - B CHANNEL

Most measurements with the HP 8508A will be done using the B probe, leaving the A probe in place as a reference. The B channel is much more sensitive since the A channel already provides the signal to which the instrument is locked.

Press [B] to display the B input voltage in Display 2. (The A reading remains in Display 1 unless you turn it off by pressing the [A] key. The A probe must still be connected in order to keep the instrument locked.) Display 2 shows

the B channel residual noise level of around 10uV when the probe is not connected.

7. DUAL-CHANNEL MEASUREMENT
The HP 8508A can display the ratio of the signals in its two channels, making it unnecessary to calculate the results of ratio measurements.

Connect the two probes to the source output using a tee, as shown in the following diagram.

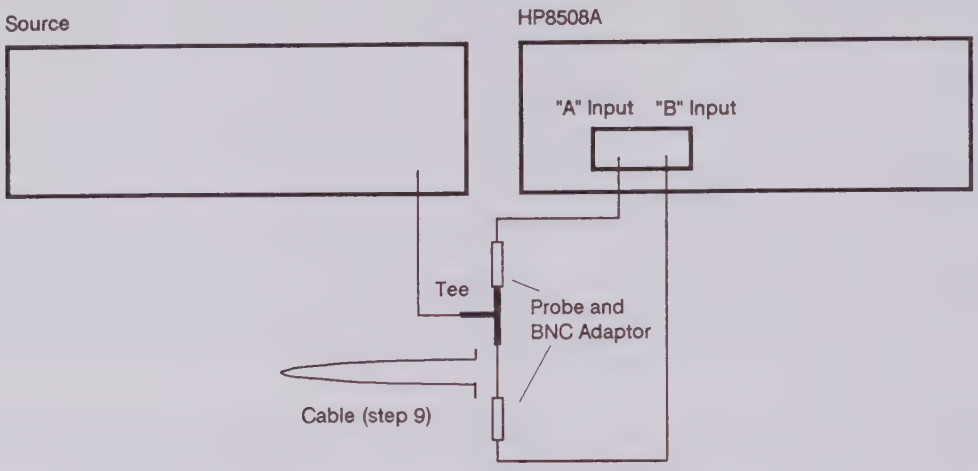


Figure 3-5. Two Probe Connection

Select [DISPLAY] **UNITS** to display the levels as voltages. (The A and B voltages in Displays 1 and 2 respectively should read approximately the same value.) Press [B/A MAG] to show the voltage ratio of B to A in Display 1. The reading should be approximately 1.0. Display 2 should be off. Press [B-A PHASE] to display the input phase difference in Display 2. The reading should be approximately 0 deg.

8. SET A REFERENCE
Press [SHIFT] then [SAVE REF] to store the current measurement as a reference and normalize readings to the saved reference value. The displays should now read exactly 1.0 magnitude, and 0.0 deg phase.

NOTE: DISPLAY 1 reads 1.0 [REL] and
DISPLAY 2 reads 0.0 [DEG] [REL]

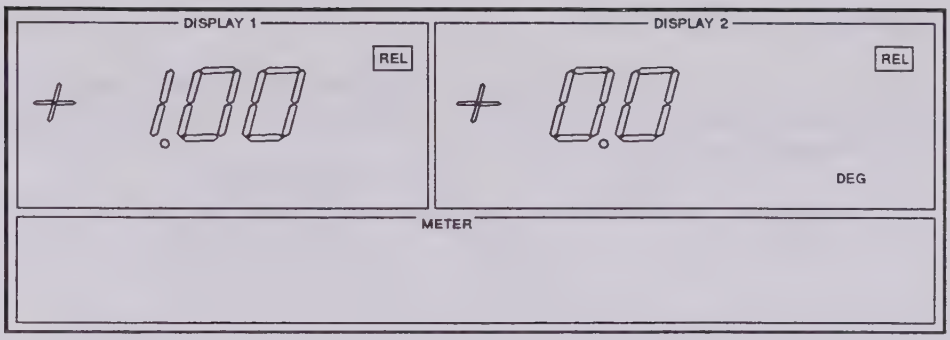


Figure 3-6. Displays

9. RELATIVE MEASUREMENT
Now insert the cable as shown in Figure 3-5. The readings are now of the voltage ratio and phase difference caused by the cable, using the reference set in step 8. Select [DISPLAY] **dB** to read the cable insertion loss in dB. The phase difference can be used to calculate the cable's electrical length.

10. REAL AND IMAGINARY
Instead of magnitude and phase, you can show the measurement results as real and imaginary components. Select [FORMAT] **REAL & IMAG** to see results in this form.

NOTE: DISPLAY 1 reads ohm and
DISPLAY 2 reads johm

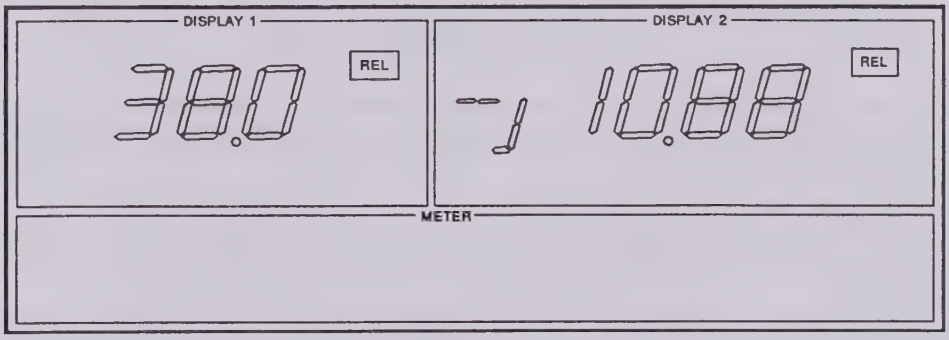


Figure 3-7. Displays

WHAT YOU HAVE ACHIEVED

You have made voltage measurements (A and B) and a vector ratio measurement (B/A MAG, B-A PHASE), and normalized the ratio to a reference.

3-9 ADVANCED MEASUREMENTS

This section will cover some simple network analysis measurements using the HP 8508A and a companion source. Transmission and reflection measurements will be covered to show how some of the features of the HP 8508A can be used to make your measurements easier.

The measurement examples will use 50 ohm devices - refer to the following section for details of configuring the HP 8508A for 50 ohm inputs.

Measurements in a 50 ohm system

50 ohm measurements can be made directly when the HP 8508A is fitted with the type-N HP 85082 Input Module, or by using adapters with the probes of the HP 85081 Input Module. The HP 11536A Feedthru is part of the HP 11570A Accessory Kit. The following diagram shows how to connect the probe adapters to make 50 ohm measurements.

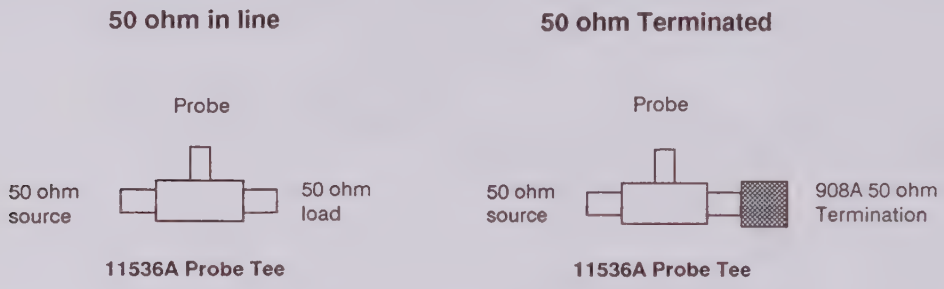


Figure 3-8. Probe to 50 ohm Options

In this example, measure the 3dB point of a low-pass filter that cuts off at around 50MHz. The circuit includes a source, and a power splitter which is used to obtain a reference signal. The filter is preceded by a 6dB pad to minimize out-of-band reflection problems.

Measurement details

1. Connect the equipment as shown below. Press [PRESET] to get the instrument to a known state, then [B] to measure the filter output.

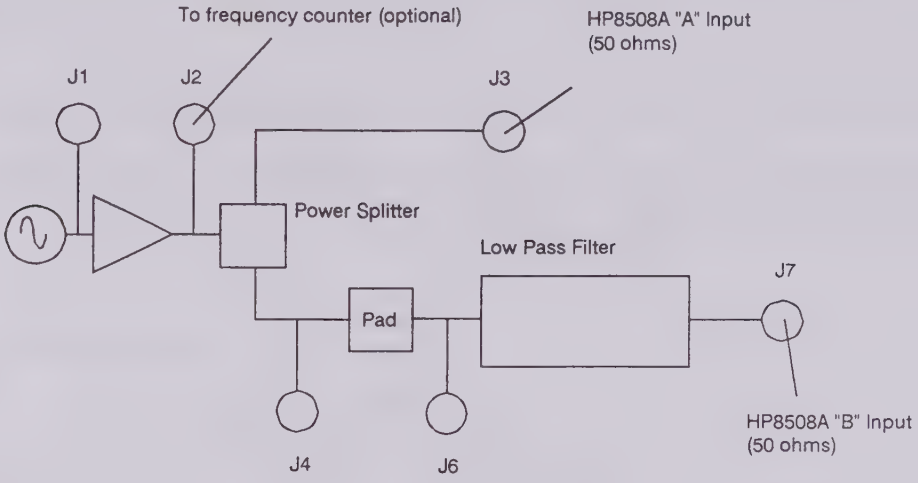


Figure 3-9. Test Setup

2. Select [METER SELECT] **DISP2** to activate the meter on the B voltage, then tune the source frequency for a maximum to set the source in the filter passband. Tuning is achieved using the trend indicators (LED's). An *increasing* level is highlighted by the top LED being illuminated. A *decreasing* level is highlighted by the bottom LED being illuminated. A *null* is indicated by both LEDs being extinguished.

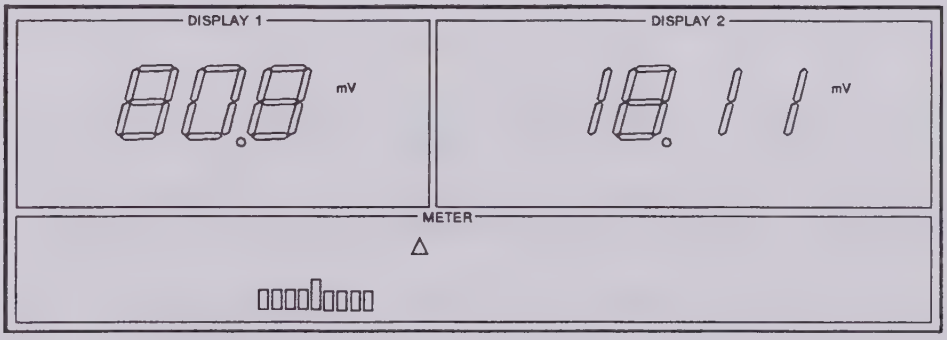


Figure 3-10. Meter Display

3. Press [B/A MAG] to measure the amplitude ratio, and select [DISPLAY] **dB** to display a log ratio.

4. Press [SHIFT] then [SAVE REF] to store the current reading, zero the magnitude reading and refer future measurements to the filter passband.

5. Now increase the source frequency until the display reads -3dB. Note the source frequency. This is the filter 3dB cutoff frequency.

a. Transmission

One good use of a CW receiver such as the HP 8508A is in the measurement of gain as a function of input level. The HP 8508A automatically displays B/A as a ratio, so effects caused by changing input level can be seen directly.

To illustrate this we'll measure the 1dB gain compression point of a 50MHz, 14dB gain amplifier. Since the output at gain compression is specified to be 10dBm, we'll use an HP 8491A 10dB attenuator at the output of the amplifier to minimize measurement errors due to high signal levels.

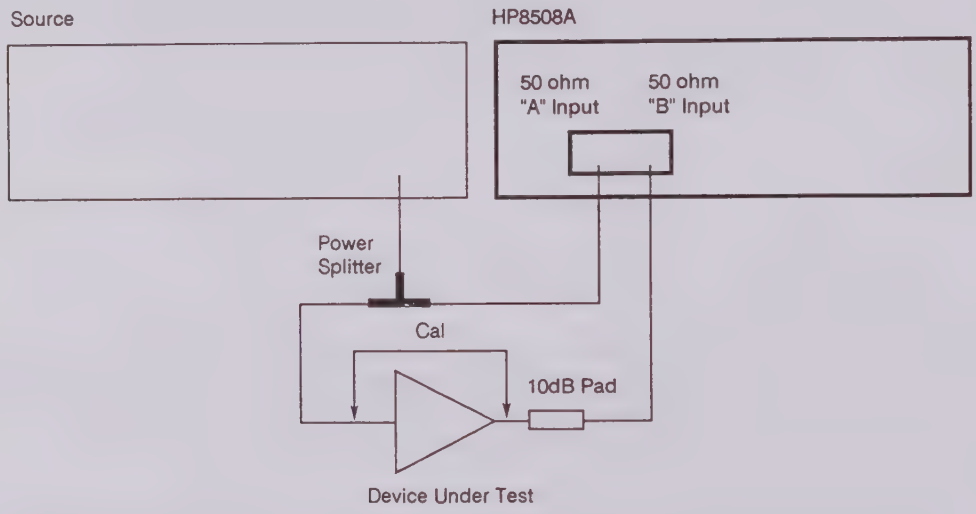


Figure 3-11. Transmission Test Setup

1. Connect the A and B inputs to the power splitter. Set the source output level in the normal operating range of the amplifier. Set the source output frequency to 50MHz. Press [PRESET] to return the HP 8508A to a known state.

2. Press [B/A MAG] to measure the magnitude ratio. Select [DISPLAY] **dB** to measure log gain. Press [SHIFT] then [SAVE REF] to store the current measurement, zero the display and remove splitter and input effects.

3. Connect the amplifier between the splitter and the B input and measure and note the gain.

4. Press [SHIFT] then [SAVE REF] to store and use this (nominal) gain as a reference and reset the reading to 0dB.

5. Increase the source output level until the HP 8508A reads 1dB. The amplifier is now operating at its gain compression point.

6. Press [REF] to remove the reference offset. Press [A MAG] to measure the input voltage (dBuV), and [POWER MEAS] to convert the reading to dBm. Since the splitter is symmetrical, the measured power at the A input will be the same as at the amplifier input to within the tracking specifications of the power splitter.

b. Reflection

The measurement of small reflections in high frequency RF systems requires careful consideration. At low levels, reflections from the device under test can be masked by leakage signals in the measuring equipment, so to make the measurement accurately, you will need to use a high directivity reflection bridge or directional coupler. Use a short circuit as a calibration standard, and measure the return loss of a precision termination.

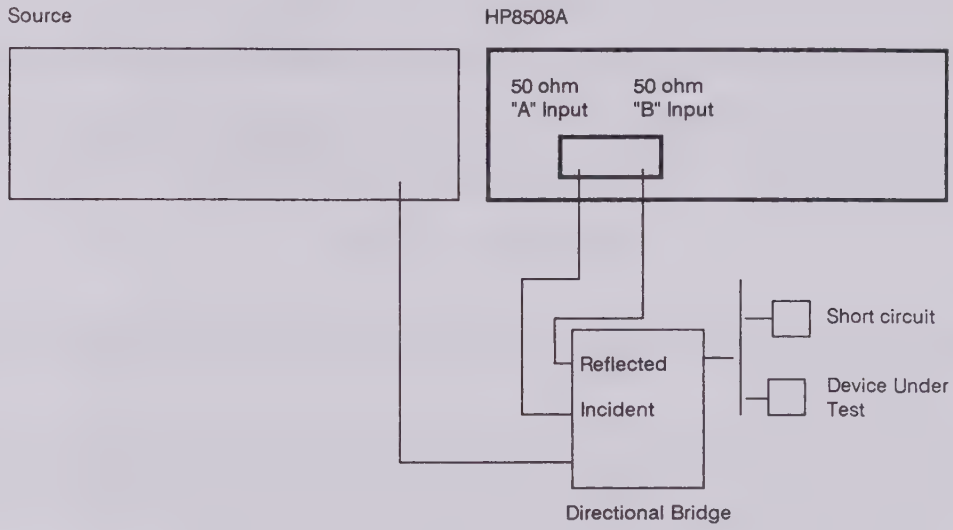


Figure 3-12. Bridge Test Setup

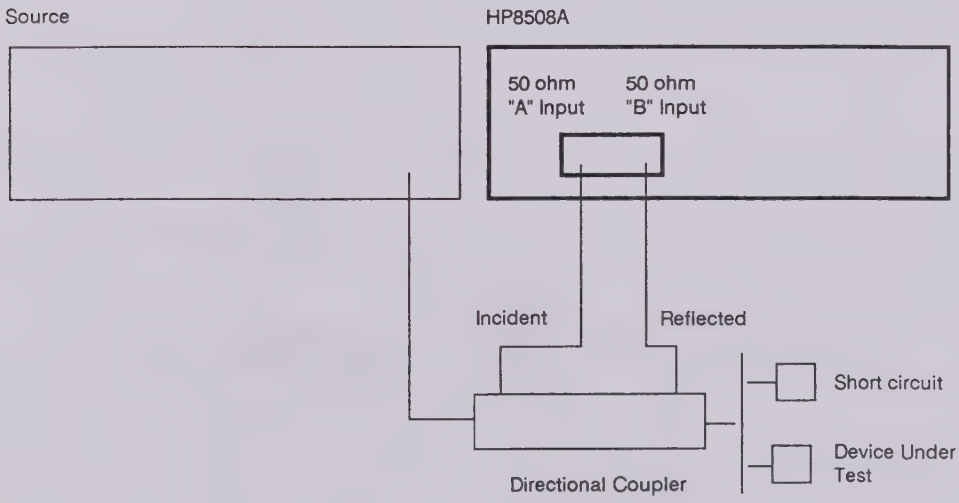


Figure 3-13. Coupler Test Setup

1. Connect the A and B inputs to the bridge or splitter as shown in one of the above diagrams (depending on the equipment you have available). Set the source power to 0dBm and frequency to the test frequency.

2. Connect a short circuit to the test port as the calibration standard. Press [PRESET] to return the HP 8508A to a known state. Select [REFL MEAS] ***rho, angle*** to measure reflection coefficient.

3. Select [REF SELECT] **SHORT** to use a short circuit as the calibration standard. Select [DISPLAY] **dB** to measure the reflection as return loss in dB. Press [SHIFT] then [SAVE REF] to store the current measurement and display a return loss of 0dB and angle 0 degrees.

4. Remove the calibration standard and connect the termination to be measured. Read the return loss directly.

The HP 8508A has conversions built in to allow you to read results in normalized impedance for use with Smith charts. To make the conversion, select [REFL MEAS] Z, and [SYSTEM IMPD] NORM. There is no need to recalibrate since the new display is computed from the same measurements as before.

c. Other functions

[HOLD VALUE] - This function is useful when you are probing in a circuit (especially dense circuits where the probe can easily slip onto another track). When the signal disappears, the display is frozen at the last reading.

To initiate this function, configure the equipment for the measurement you want to make (A, B/A, B). Now press [HOLD VALUE]. The LED at the side of the key will illuminate. Probe on the circuit. (Use the A probe if "A" only is active or the B probe if both are active.) Lift the probe when you are ready to take a reading. The display(s) will freeze and hold the reading. The function LED will flash to show that the hold mode is active. To make a new measurement, probe on the circuit. The instrument will automatically re-arm the function.

[REF SELECT] **LOAD** - This function allows the use of a simple two resistor tee to enable you to make reflection measurements up to 100MHz. In this case, a termination is used as the calibration standard.

Choose LOAD with the following test setup.

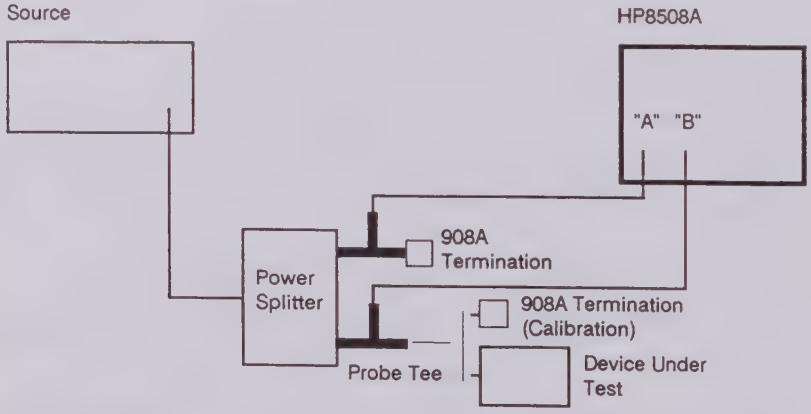


Figure 3-14. Probe Inputs

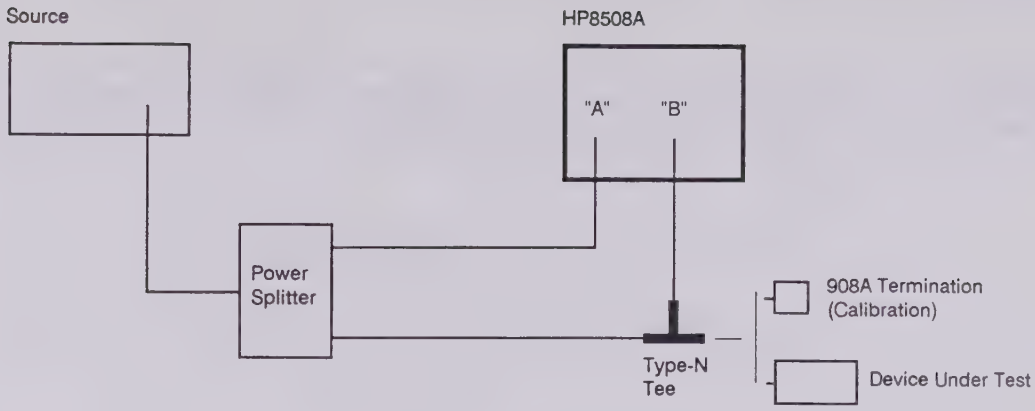


Figure 3-15. 50 ohm Inputs

Connect the termination (calibration standard). Press [SAVE REF]. Replace the termination with the device-under-test (DUT). Read result.

[LOCK RANGE] - Using this function provides a faster lock response in automatic systems and when making repetitive measurements near a specification range boundary. This function overrides the automatic selection of frequency lock range.

[MAG RANGE] - This function has two uses. First, it overrides the automatic selection of the magnitude display range allowing control of display resolution. Second, it enables you to control the rear panel output range - useful when using auxiliary equipment.

[CAL TEST] - This function controls the test output and also performs an internal calibration. You should use this function regularly to ensure that the instrument maintains its optimum performance. This function should be used after instrument warm-up (allow a 30 minute warm-up period). In addition, if the instrument is used in a constant environment, this function should be used at least once per day.

[DIR ANALG OUT] - This function activates the rear panel outputs and locks the instrument state. Using the rear panel outputs for narrowband sweeps gives a faster response.

[SHIFT] [DELAY] - This function enables you to make single-point delay measurements by converting the measured phase difference to a delay measurement.

Set for transmission. Choose the first frequency on the synthesizer. Select [DELAY]. Press [SAVE VALUES] to save the measurement. Set the synthesizer to the second frequency (+4kHz) and read the delay.

d. 20kHz Receiver

The HP 8508A can be used with the input module extender (HP part number 08508-60032) as a 20kHz receiver. This feature can be used to allow magnitude and phase measurements on a 20kHz signal. For example, to make delay measurements by amplitude modulating an RF signal. In this case, the HP 8508A measures the phase change in the modulation envelope which can be converted to delay.

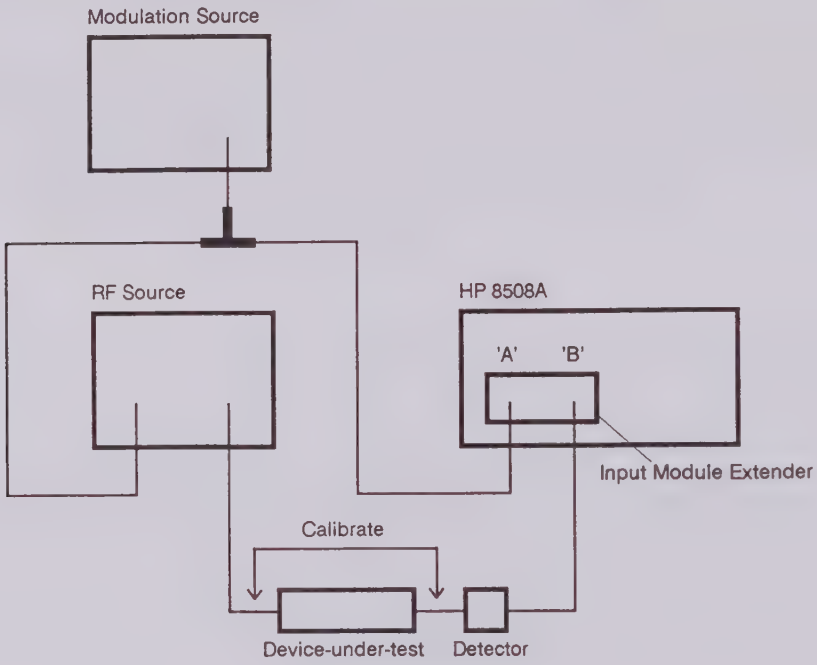


Figure 3-16. 20kHz Receiver Setup

1. Set the RF source to the frequency of interest. Ensure that AM is on, and set the amplitude to give approximately -10dBm at the detector input. Set the modulation source to 20kHz at a level compatible with the RF modulation input. Using an oscilloscope, check that the detected signal is an undistorted sinewave. Reset the AM percentage and the modulation source level if necessary.

2. To calibrate the circuit, configure the equipment as shown in Figure 3-16, without connecting the device to be tested.

3. On the HP 8508A, press [PRESET] to return the HP 8508A to a known state. Press [B-A PHASE] to measure amplitude on Display 1 and phase on Display 2. Press [LOCK RANGE] [SHIFT] [VIEW RANGE] and use the "up"/"down" arrow keys to select band 20 (0.02 - 0.02MHz). Now press [SHIFT] [SAVE REF] to store the measurement as a reference and normalize readings to the saved reference value.

4. Insert the device to be tested between the RF source and the detector.

5. Convert the modulation envelope phase change (which is shown on Display 2) to delay, using the following formula:

$$t\,(d) = \frac{d\,(\text{phase})}{f\,(m) \times 360\text{deg}}$$

where:
- t (d) = delay in seconds
- d (phase) = envelope phase shift in degrees
- f (m) = modulation frequency in Hz.

In this case, the modulation source is 20kHz. Substituting this in the formula gives:

$$t\,(d) = \frac{d\,(\text{phase})}{7.2E + 6}$$

3-10 TYPICAL CONFIGURATIONS

Probing measurements with external source

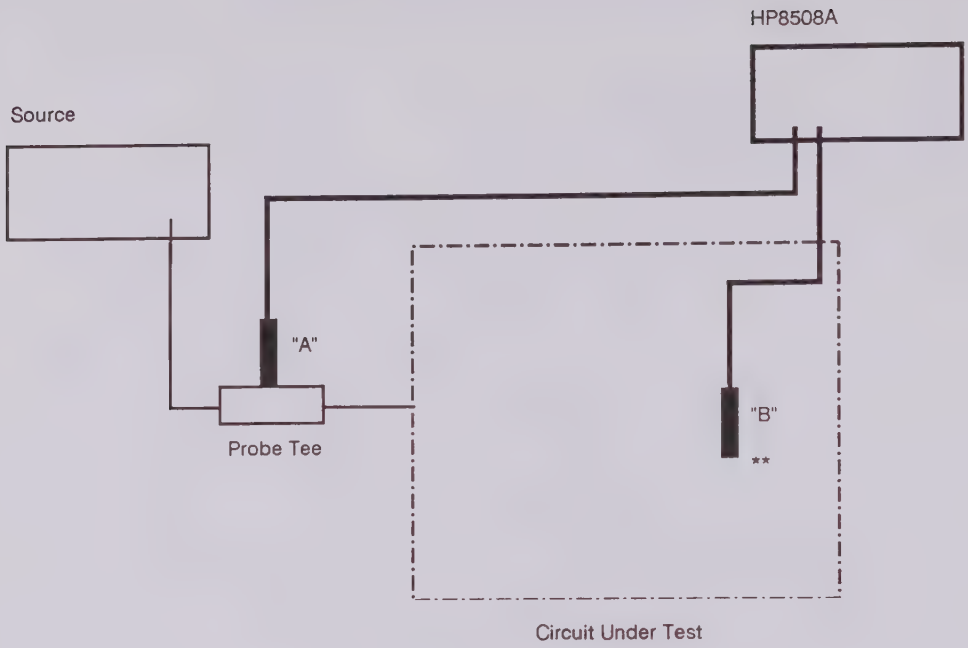


Figure 3-17. Probing Measurements Setup

Equipment:

HP 8656B Synthesized Signal Generator
HP 8508A Vector Voltmeter
HP 11536A Probe Tee (Part of HP 11570A Accessory Kit)
HP 11851B Cable Kit (1 cable required in this setup)
or
HP 11500B RF Cable Adapter from type-N to circuit under test if required
** Probe Accessories (if required)
HP 11576A 10:1 Divider
HP 10216A DC Block
HP 5060-0549 Spanner Top Assembly

Transmission measurements in 50 ohms - Probe inputs

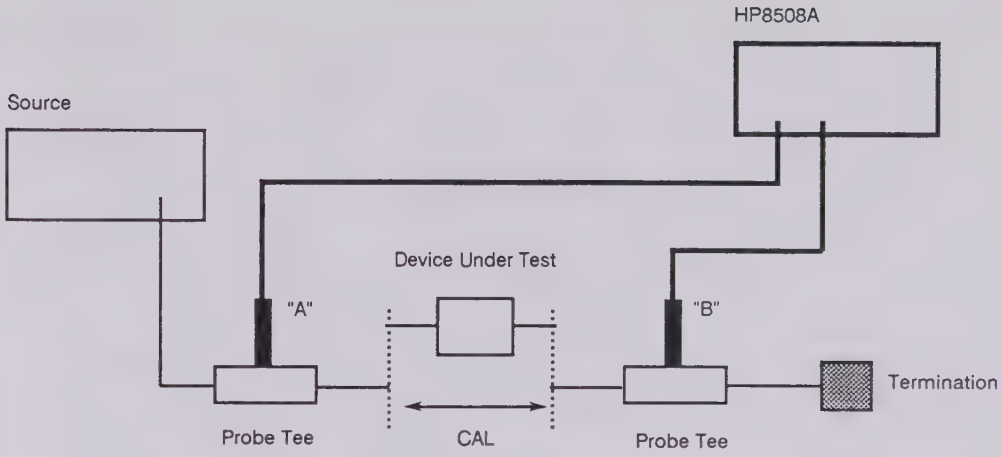


Figure 3-18. Transmission Measurements Setup

Equipment:

HP 8656B Synthesized Signal Generator
HP 8508A Vector Voltmeter
HP 11570A Accessory Kit (includes 2 HP 11536A Probe Tee and 1 HP 908A Termination)
HP 11851B Cable Kit (1 cable required in this setup)
or
HP 11500B RF Cable Adapter from type-N to DUT if required

Transmission measurements in 50 ohms - Direct inputs

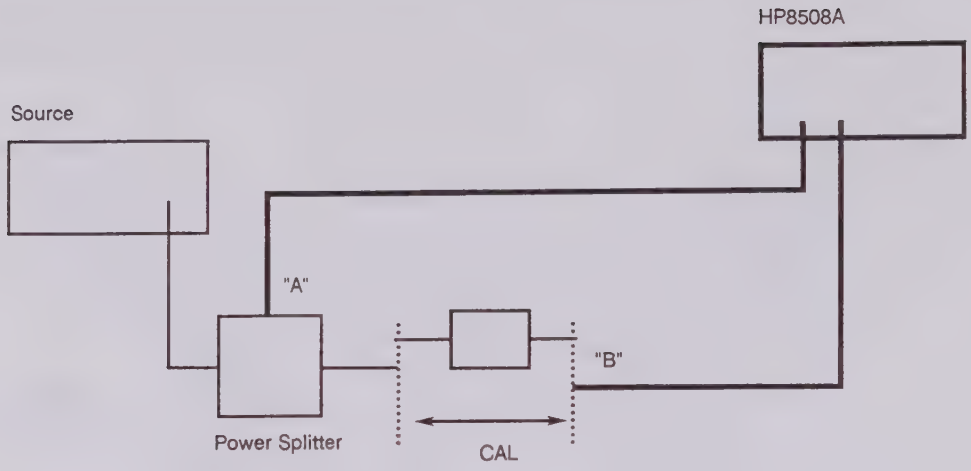


Figure 3-19. Transmission Measurements Setup

Equipment:

HP 8656B Synthesized Signal Generator
HP 8508A opt 050 Vector Voltmeter with 50 ohm Input Module
HP 11851B Cable Kit (3 cables required in this setup)
HP 11549A Power Splitter (dc to 1GHz)
or
HP 11667A Power Splitter (dc to >2GHz) Adapter from type-N to DUT if required

Reflection measurements in 50 ohms - Probe inputs, dual directional coupler

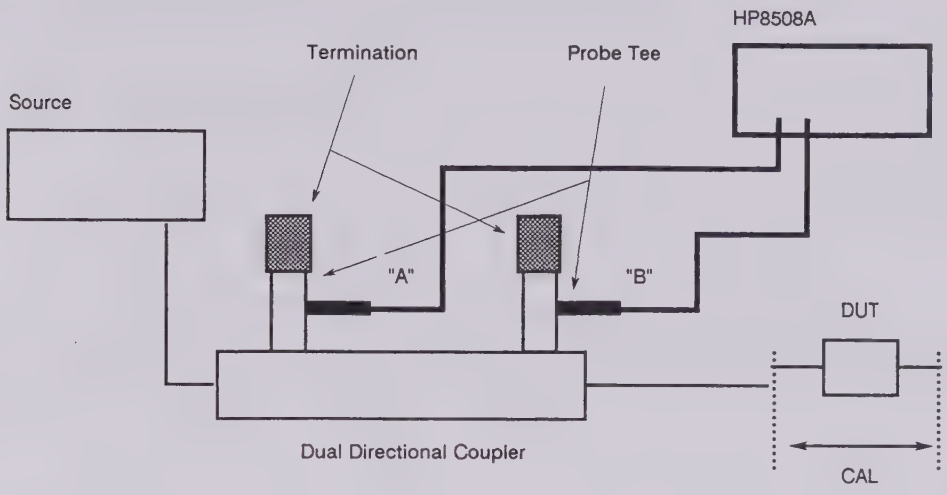


Figure 3-20. Reflection Measurements Setup

Equipment:

HP 8656B Synthesized Signal Generator
HP 8508A Vector Voltmeter
HP 11570A Accessory Kit (includes 2 HP 11536A Probe Tee and 1 HP 908A Termination)
HP 908A Termination (total of 2 required)
HP 77xD Dual Directional Coupler (See "Related Products" section for frequency ranges)
HP 11851B Cable Kit (1 cable required in this setup)
or
HP 11500B RF Cable Adapter from type-N to DUT if required
Calibration Standard (Same as DUT connector)

Reflection measurements in 50 ohms - Direct inputs, reflection bridge

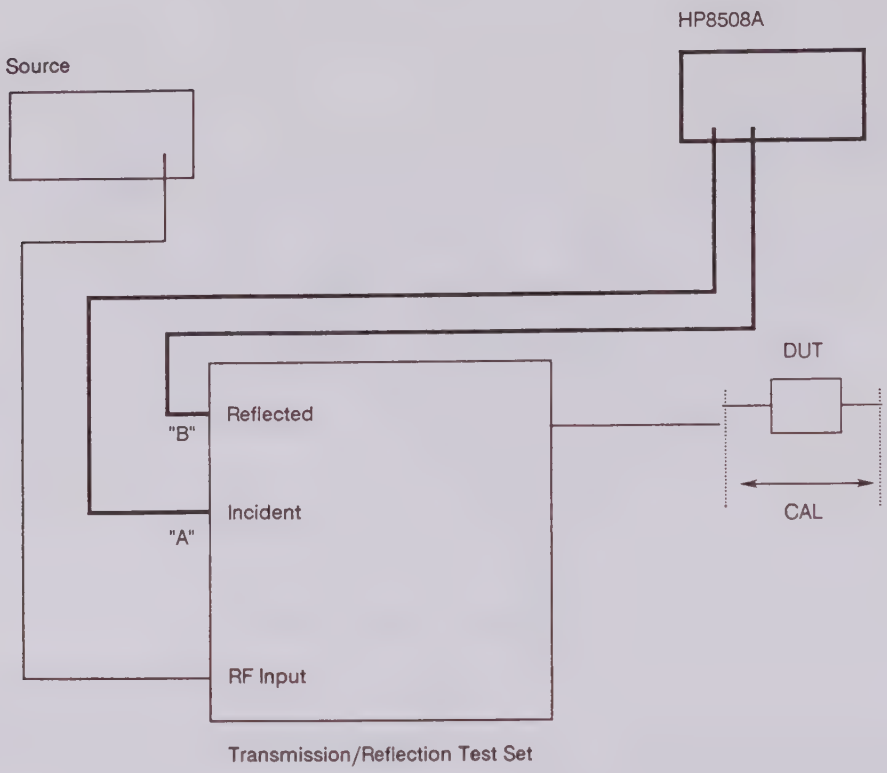


Figure 3-21. Reflection Measurements Setup

Equipment:

HP 8656B Synthesized Signal Generator
HP 8508A opt 050 Vector Voltmeter with 50 ohm Input Module
HP 85044A Transmission / Reflection Test Set
HP 11851B Cable Kit (3 cables required in this setup)
Adapters from type-N to DUT if required
Calibration Standard (Same as DUT connector)

3-11 REMOTE OPERATION - THE HEWLETT-PACKARD INTERFACE BUS

The Vector Voltmeter is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB) which is Hewlett-Packard's implementation of IEEE Standard 488.1. This section gives details of remote operation, including capabilities, addressing, input and output formats, status and service requests.

All front panel functions, except the LINE switch, are programmable via HP-IB. In addition, there are HP-IB commands offering capabilities under remote control which are not available from the front panel keyboard.

The HP-IB commands used in the Vector Voltmeter conform to the standards set by document IEEE 488.2-1987, "Codes, Formats, Protocols and Common Commands for use with ANSI/IEEE Std 488.1, 22 January 1987". Consult the standards document for details of the commands and structures recommended.

For more information about HP-IB, refer to IEEE Standard 488.1 (or the identical ANSI Standard MC1.1), the Hewlett-Packard Electronic Systems and Instruments catalog, the booklet "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058), and "Tutorial Description of the Hewlett Packard Interface Bus" (HP part number 5952-0156, Nov 87). Anyone who is unfamiliar with the IEEE 488 Standards should read the Tutorial Description as an introduction.

HP-IB Capability

This section gives a general description of HP-IB capabilities as they apply to the Vector Voltmeter. The instrument's command set is summarised in Table 3-2 and command details are given in the Command Reference section.

HP-IB system operation normally relies on three types of bus device behaviour, as follows:

* A LISTENER is capable of receiving data over the bus when addressed to do so. There can be multiple listeners simultaneously active.
* A TALKER is capable of transmitting data over the bus when addressed to do so. There can be only one active talker at a time.
* A CONTROLLER specifies the talker and listener(s) for an information transfer, including itself. There can be only one active controller at a time.

Local and Remote Operation

The Vector Voltmeter can operate under either local or remote control. In local mode all front panel controls are operational and control the instrument. In remote mode, all front panel controls are inoperative (except [LCL] when not in Local Lockout), the instrument being controlled by the HP-IB controller. The front panel display reflects the remote programming commands received, unless the display is switched off.

At power-on, the instrument assumes the local state. Under local control all HP-IB instrument commands will be ignored. To gain control over HP-IB the controller must put the instrument into the remote state. This is accomplished by setting the Remote Enable (REN) bus control line true and sending the Vector Voltmeter's HP-IB Listen Address.

In local mode, the Vector Voltmeter's front panel controls are fully operational and it will respond to the Remote message. Whether it is addressed or not, it will also respond to the Clear, Local Lockout and Clear Lockout/Local messages. When addressed to talk, the Vector Voltmeter can issue Data messages and the Status Byte message. Whether addressed or not, it can issue the Service Request message.

Local Lockout. Local lockout disables the LCL key and allows return-to-local only under program control. Local Lockout is recommended for purely automatic applications.

Remote-to-Local. The instrument switches to local whenever it receives the Local message (GTL) or the Clear Lockout/Local message (REN false). If not in Local Lockout mode, the instrument switches to local when the front panel LCL key is pressed.

NOTE
Return-to-local can also be accomplished by setting the Vector Voltmeter's LINE switch to OFF then to ON. However, this technique has some disadvantages:

a. It defeats the purpose and advantage of local lockout (that is, the system controller loses control of a system element).

b. There are several HP-IB conditions which reset to default states at turn-on.

Addressing

The Vector Voltmeter's HP-IB address is stored in permanent memory, so that it is remembered through power cycling. The address can be set from the front panel as follows:

a. Press [SHIFT] [ADDRESS] to display the current address.

b. Use the arrow keys to select the required address (0-30), which becomes effective immediately.
The instrument's normal address setting is 8.

c. Press [SHIFT] [ADDRESS] or any other function to return to normal operation.

The Vector Voltmeter can be Addressed to Listen, Addressed to Talk, or Unaddressed. It is Addressed by putting either its Listen Address (HP-IB Address+32) or its Talk Address (HP-IB Address+64) onto the bus in command mode (ATN true & IFC false). It remains Addressed to Listen until it receives its Talk Address or a Universal Unlisten command. It remains Addressed to Talk until it receives its Listen Address or an Untalk command.

Power-on Default Conditions

Several HP-IB parameters are reset at power-on. The parameters and their default conditions are listed below.

* HP-IB Local Mode
* Unaddressed
* Service Request Enable Register cleared
* Status Reporting Structure cleared
* Trigger Source Freerun
* Display State active

Should the Vector Voltmeter fail part of its power-on test sequence the Error code will be placed in the Error Queue. (See also SYSTem:ERRor?)

Data Messages

The Vector Voltmeter communicates on the interface bus primarily with Data messages. Data messages consist of a sequence of bytes sent over the bus data lines, when the bus is in the data mode (ATN false). The Vector Voltmeter receives Data messages when addressed to listen and sends Data messages or the Status Byte message when addressed to talk. All instrument operations available in local mode can be performed in remote mode via Data messages except for changing the LINE switch.

Receiving the Data Message

The Vector Voltmeter responds to Data messages when in remote mode (REN true) and addressed to listen.

Instrument Commands

Instrument commands are sent as data messages. Commands may be linked together using appropriate punctuation, as defined in the IEEE 488.2 standard. Allowable commands for the Vector Voltmeter are described in Table 3-2. Either upper or lower case characters are accepted. Many commands have a query option that returns results or allows the state of the function to be checked remotely. Figure 3-22 shows a typical command.

Figure 3-22. A Typical Command

Triggered Measurements

A feature only available via remote programming is selection of free-run or HP-IB triggering. With triggering set to free-run, the Vector Voltmeter measures continuously, outputting data to the display and (if requested) the HP-IB as each measurement cycle is completed.

When the trigger source is set to BUS, the Vector Voltmeter will make triggered measurements. A trigger is initiated by the trigger message, a Group Execute Trigger HP-IB command or a *TRG Instrument command.

In triggered mode, internal settings can be altered, but the instrument is inhibited from measuring and sending results to the front panel or the HP-IB until a trigger is received. When triggered, the instrument completes one cycle of the current measurement and then waits for another trigger. The results of the completed measurement are held, and can be obtained by using the FETCh? or MEASure command. Returning the Vector Voltmeter to local control forces the trigger source to the freerun mode.

Sending the Data Message

The Vector Voltmeter sends Data messages when addressed to talk and has data to output. The output format for each message is shown in Table 3-2.

Receiving the Remote Message

The Vector Voltmeter switches to remote operation upon receipt of the Remote message. The Remote message has two parts:

* The Remote Enable bus control line (REN) set true, and
* A Device Listen Address received once (while REN is true).

When the Vector Voltmeter switches to remote, the front panel **R** annunciator turns on.

Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. If addressed to listen, the Vector Voltmeter returns to front panel control when it receives the Local message. If the instrument is in local lockout when the Local message is received, front panel control is returned, but lockout is not cleared. Unless it receives the Clear Lockout/Local message, the Vector Voltmeter will return to local lockout the next time it goes to remote. No front panel instrument settings are changed by the transition from remote to local, but the following parameters are set:

* Trigger State is set to freerun;
* Average Count set to 5;
* Display State on;

When the Vector Voltmeter goes to local mode, the front panel **R** annunciator turns off. However, when the Vector Voltmeter is being addressed (whether in local or remote), its front panel **L** or **T** annunciator remains lit.

Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If in remote mode, the Vector Voltmeter responds to the Local Lockout message by disabling the front panel [LCL] key. The local lockout mode prevents loss of system control due to accidentally pressing front panel keys. When in local lockout mode, the Vector Voltmeter can be returned to local only by the controller (using Local or Clear Lockout/Local messages) or by setting the LINE switch to OFF and ON.

Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Vector Voltmeter returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the Vector Voltmeter goes to local mode, the front panel **R** annunciator turns off.

Receiving the Pass Control Message

The Vector Voltmeter does not respond to the Pass Control message since it cannot act as a controller.

Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the Vector Voltmeter becomes unaddressed and stops talking and listening.

Sending the Status Bit Message

The Vector Voltmeter has no Parallel Poll capability, and makes no response to the status bit message.

Other Messages

Other messages sent by the Vector Voltmeter are responses to the query option of some commands and status information. In general, the query options return the recommended form of the corresponding command. This is either a number (where the command sets a range or sends data, or sets the function ON or OFF), or a string (where the command itself is a string). Status functions return a number to be decoded to determine conditions which have set status bits.

Service Requests

HP-IB devices may request service from the controller by asserting the SRQ bus control line. The controller usually responds to this signal by asking each device on the bus in turn for its Status Byte. If bit 6 is set, it indicates that the device requires service and the controller looks at the remaining bits in the Status Byte for further information.

The interpretation of these bits depends on whether the device complies only with IEEE488.1 or, like the Vector Voltmeter, with IEEE488.1 and IEEE488.2. Bit 6 has two distinct functions. Within IEEE488.1 it is the Request Service (RQS) bit and within IEEE488.2 is the Master Summary Status (MSS) bit. IEEE488.2 also defines bit 5 as the Event Summary Bit (ESB) and bit 4 as the Message Available Bit (MAV).

When dealing with service requests, a key operational difference emerges between instruments which comply only with IEEE488.1 and those which meet IEEE488.2 as well. If the Status Byte of a IEEE488.1 instrument is read (by a Serial Poll Enable bus command), the RQS bit is cleared as a consequence of the read operation . A Serial Poll of an IEEE488.2 instrument produces the same effect. IEEE488.2 provides a further command , *STB?, to read the Status Byte. If this command is used, the state of the MSS bit is returned and the bit is not cleared when read.

These differences arise because IEEE488.2 defines a status reporting structure which extends the specifications of the original standard. In IEEE488.2, the Status Byte summarises the underlying status data structures and the concept of enabling service requests is defined.

Enabling Service Requests

The service request enabling operation is shown in Figure 3-24. The user can set bits in the Service Request Enable Register (SRER). These bits correspond to bits in the Status Byte. If a bit is set in the SRER, it enables the instrument's ability to generate an SRQ when the corresponding event occurs. For example, setting bit 4 in the SRER will produce a service request when the MAV bit is set .

If a bit is set in the Status Byte, but not enabled in the SRER it cannot cause bit 6 to be set and consequently will not initiate an SRQ, although it will be read when the Status Byte is read.

Refer to Figure 3-23 for an example of SRQ enabling and handling.

```
10    ! HP8508A  Example HP-IB SRQ Enable & Handling Program
20    !
30    ! This program continually sends an illegal command to the 8508A,
35    ! and deals with the returned SRQ.  It also reports the 8508A
37    ! going out of lock, when the A channel signal is removed.
40    !
50    Addr=708                              ! Vector Voltmeter Address
60    ON INTR 7 CALL Intr7                  ! Set up SRQ interrupt handler call
70    !
80    CLEAR Addr                            ! Clear interface
90    OUTPUT Addr;''*RST;*CLS''             ! Reset Vector Voltmeter
100   !
110   OUTPUT Addr;''*ESE 36"                ! Enable SRQ on Query or Command Error
140   !
150   OUTPUT Addr;''STATUS:OPER:PTR 4"      ! Enable SRQ when 8508A becomes
180   OUTPUT Addr;''STATUS:OPER:ENAB 4"     ! Unlocked
200   !
210   OUTPUT Addr;''*SRE 160"               ! Generate SRQ on above conditions
230   !
240   ENABLE INTR 7;2                       ! Enable SRQ interrupts in BASIC
250   REPEAT
260         OUTPUT Addr;''SYST:KET 1"       ! An incorrect Command to generate an SRQ
270         WAIT .5
280   UNTIL 1=0                             ! Repeat Forever
290   END
300   !
310   !
320   SUB Intr7
330         DIM Err_message$[100]
340         Addr=708
350         OUTPUT Addr;''*STB?''
360         ENTER Addr;Stat                 ! Read Status Byte
370         IF BIT(Stat,5) THEN
380               OUTPUT Addr;''*ESR?''     ! Read & Clear Standard Event Register
390               ENTER Addr;Std_event
400               IF BIT(Std_event,5) THEN PRINT ''Command Error''
410               IF BIT(Std_event,2) THEN PRINT ''Query Error''
420               OUTPUT Addr;''SYST:ERR?''
430               ENTER Addr;Err_message$
440               PRINT Err_message$
450   END IF
```

```
460         IF BIT(Stat,7) THEN
470               PRINT ''HP8508A UNLOCKED''
480               REPEAT
490                     OUTPUT Addr;''STATUS:OPER:COND?''
500                     ENTER Addr;Condition
510               UNTIL BIT(Condition,2)=0  ! Wait for lockup again
520               PRINT ''HP8508A LOCKED''
530               OUTPUT Addr;''*CLS''      ! Clear ALL Status Structures
540         END IF
550         !
560         ENABLE INTR 7                   ! re-enable SRQ
570   SUBEND
```

Figure 3-23. SRQ Enabling and Handling

Sending the Service Request Message

The Vector Voltmeter sends the Service Request message in either local or remote mode. When it is sending the message, the front panel S annunciator lights. The message is cleared when a serial poll is executed by the controller or when a *CLS (Clear Status) instrument command is received.

Sending the Status Byte Message

The Vector Voltmeter sends the Status Byte message after receiving a Serial Poll Enable (SPE) bus command and when addressed to talk. It complies with IEEE488.2, so bits 4 and 5 are defined as MAV and ESB, respectively. The Vector Voltmeter also makes use of bit 7 as the Operation Status Register Summary Bit but all other bits are unused. The bit pattern of the Status Byte is shown in Figure 3-25.

Once the Vector Voltmeter receives the SPE bus command, it is no longer able to alter the Status Byte. If a bit has been enabled and that condition occurs after bit 6 has been set, the bit is stored in a buffer and is read the next time the Vector Voltmeter receives the SPE bus command.

The Status Byte and any Service Request message pending will be cleared if a *CLS (Clear Status) instrument command is received by the Vector Voltmeter.

Status Reporting

The IEEE 488.2 Standard describes a status reporting structure so that controllers know how to ask a device such as the Vector Voltmeter for its status. Figure 3-24 shows an overview of the status reporting structure.

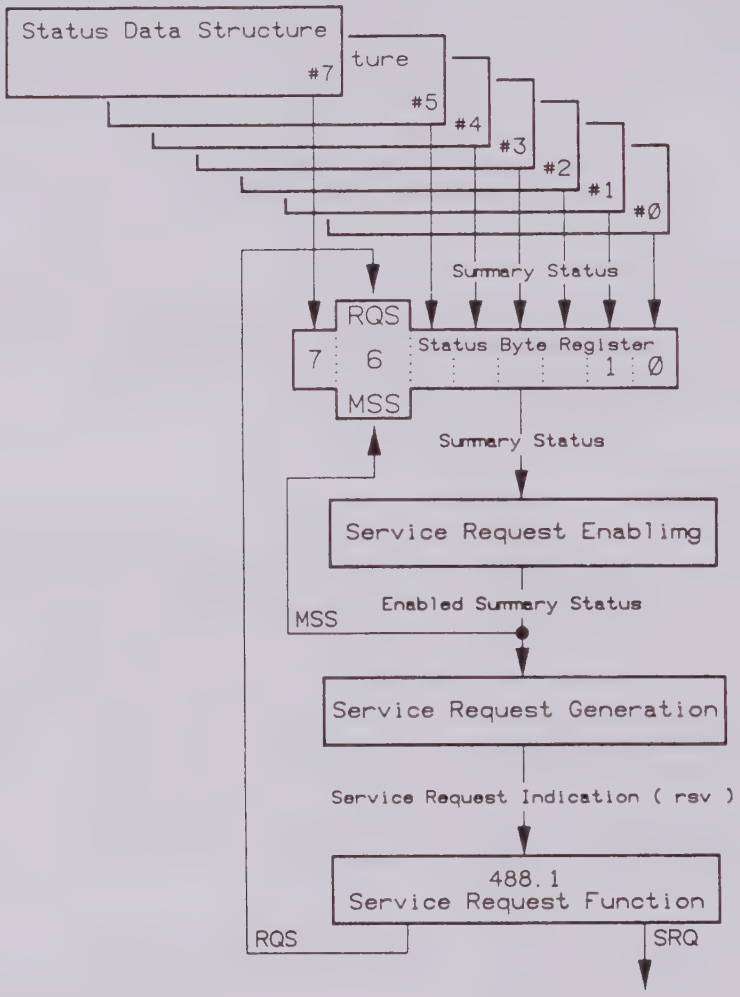


Figure 3-24. IEEE488.2 Status Reporting Structure Overview

Status Data Structures

IEEE488.2 allows the Status Byte to contain up to seven single bit summary messages from data structures, but the Vector Voltmeter only makes use of bits 4, 5 and 7 as described earlier in Sending the Status Byte Message. The status data structures are queues or event registers and the summary bits are used as follows:

* Bit 4 (MAV) reports the status of the Output Queue.
* Bit 5 (ESB) reports the status of the Standard Event Status Register.
* Bit 7 reports the status of the Operation Status Register.

Figure 3-25 shows the Standard Status Model for IEEE488.2 instruments. Two of the Vector Voltmeter's data structures are not shown, but are described later. The Operation Status data structure is similar to the Standard Event Status data structure and the Error Queue is summarised in the error bits of the Standard Event Status Register.

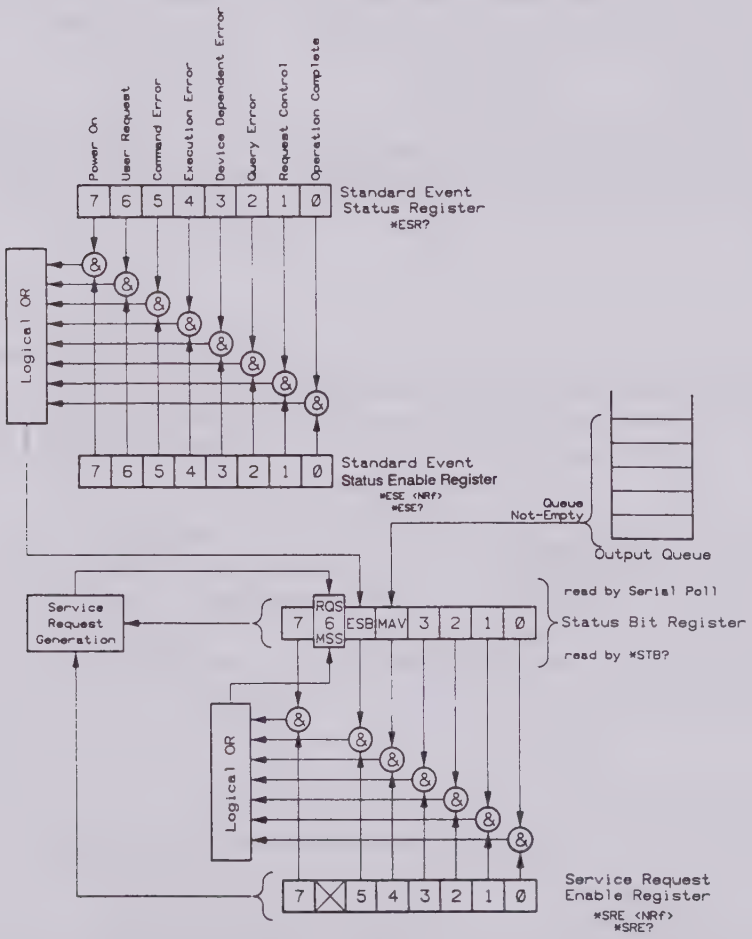


Figure 3-25. Standard Status Model

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Queues

Queues permit a device to report status or other information in a sequential manner. Each queue has a summary message bit which indicates that the queue contains some information. This bit will be TRUE when the queue contains any information, otherwise it will be FALSE. Reading a queue will remove a piece of information from it, and a queue is considered empty when it no longer contains any information. Queues can be cleared by reading all the information in them.

The Output Queue

There are two queues in the status reporting structure of the Vector Voltmeter.

The Output Queue is a "first-in, first-out" (FIFO) queue. It stores output messages until they are read from the instrument. The availability of data is summarized in the MAV bit of the Status Byte. The Output Queue is read by addressing the instrument to talk and then handshaking the bytes. It can be cleared by the Reset Command, the Device Clear Command (IEEE488.1) or by power on.

The Vector Voltmeter also has an Error Queue, which operates as a FIFO and stores error messages until they are read from the Vector Voltmeter. The Error Queue is summarised in the error bits (bits 2 to 5, inclusive) of the Standard Event Status Register. It is read by the SYSTem:ERRor ? command and can be cleared by using the Clear Status command (*CLS). When the Error Queue is empty, the string "0, NO ERROR" is returned.

Event Registers

Event Registers capture changes which occur within a device. Each bit in an event register corresponds to some device condition. Bits become TRUE when some pre-defined device condition transition occurs. The event register bits are latched so that once they become TRUE they cannot be cleared except by the user. There are two means of clearing an event register. Reading a register will clear it and the Clear Status command (*CLS) will clear all event registers.

The Vector Voltmeter uses two kinds of transition filter for setting these event bits TRUE:

1. Positive Transition. The event becomes TRUE when its condition makes a FALSE to TRUE transition.

2. Negative Transition. The event becomes TRUE when its condition makes a TRUE to FALSE transition.

See Figure 3-26 for a detailed representation of the register model for the status data structure.

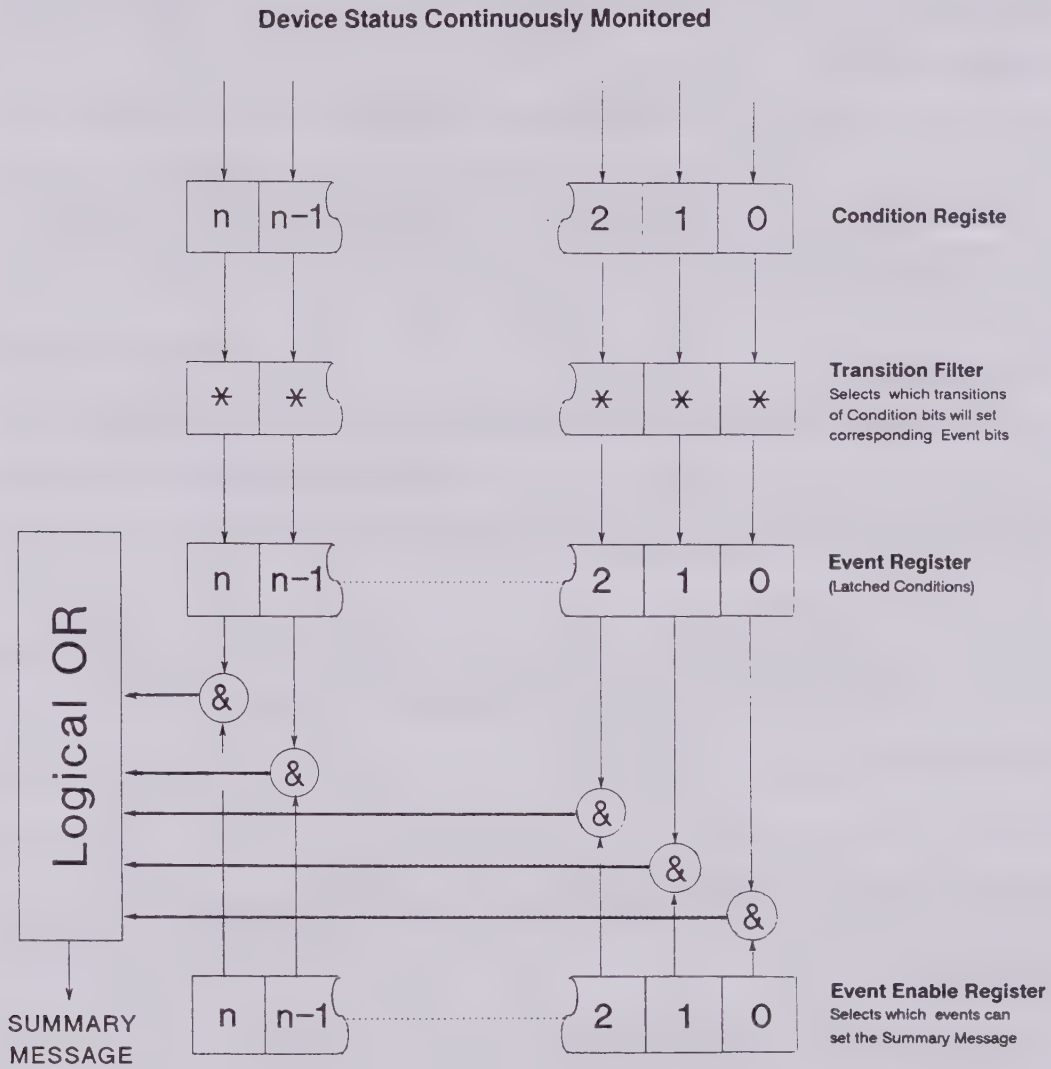

Figure 3-26. Register Model for the Status Data Structure.

The instrument also provides a Standard Event Status Enable Register and an Operation Status Enable Register and provides further commands to read them. These registers work in the same way as the Service Request Enable Register described earlier in Sending the Status Byte Message.

Standard Event Status Register (SESR)

Figure 3-25 shows the operation of the Standard Event Status Register. This is a specific application of the event registers discussed previously and its bit definitions are as follows:

Bit 5 - Command Error (CME)

This bit indicates that the device has detected a command error. The following events cause a command error.

1. An IEEE 488.2 syntax error. This means that the device received a message which did not follow the syntax defined by the IEEE488.2 standard. For example, it received data which violated the device listening format.
2. A semantic error occurred. For example, the device received an incorrectly spelled command. Another example would be that the device received an optional IEEE488.2 command which it does not implement.
3. The device received a Group Execute Trigger (GET) inside a program message.

Bit 4 - Execution Error (EXE)

This bit indicates that the device detected an error while trying to execute a command. It indicates that:

1. A <PROGRAM DATA> element received in a command was outside the legal range for the device, or inconsistent with the operation of the device.
2. The device could not execute a valid command due to some device condition.

Bit 3 - Device-dependent Error (DDE)

A device-dependent error is any device operation which did not execute properly due to some internal condition such as overrange. It indicates that the error was not a command, query, or an execution error.

Bit 2 - Query Error (QYE)

This bit indicates:

1. An attempt to read data from the Output Queue when no data was present.
2. That data in the Output Queue was lost. An example of this would be queue overflow.

Bit 0 - Operation Complete (OPC)

This bit indicates that the device has completed any pending operations and is ready to accept new commands. This bit is generated only in response to the Operation Complete (*OPC) command.

SESR Operation

The SESR operates in the same manner as the Event Registers described earlier. It can only be cleared by:

1. a Clear Status command (*CLS).
2. reading it (*ESR?).
3. a power-on transition .

The associated Standard Event Status Enable Register is written with the Enable Status (*ESE) command and read with the Enable Status (*ESE?) query.

Register Bit Coding

The Status Byte, SESR, Operation Status Register and Transition Filters are set using a value which determines the conditions to be enabled. The weights of each of the bits to be enabled are summed to obtain the value required. Table 3-1 shows the weighting of each bit for each of the registers.

Table 3-1. Register Bit Coding

Bit	7	6	5	4	3	2	1	0
Weight	128	64	32	16	8	4	2	1

HP-IB Response Formats

Results returned by the HP 8508A from measurement queries take the ASCII form:

<+>|<->D.DDDE<+>|<->DD<term>

That is a leading sign, a four digit mantissa between 1.000 and 9.999, an exponent designator "E" or "e", an exponent sign, a two digit exponent between 00 and 99 and a terminator.

The value is always in fundamental units (volts, ohms, watts, dB etc.). The terminator <term> depends on the data requested, as follows:

<term> is a comma (,) where another data item follows as part of the same result.

<term> is a semicolon (;) where the data item completes a result and another result follows.

<term> is linefeed <lf> with EOI set true where the data item is the last or only part of a result.

Using the SYSTem:FORMat command results can also be coded as 64 bit Floating Point numbers, in IEEE488.2 Definite Length Arbitrary Block Response Data format. This will be of the form ASCII characters '#' '1' '8' followed by eight data bytes in IEEE 754-1985 double precision format.

HP-IB Command Set Summary

Table 3-2. Command and status message summary

Description	Query (1)	Command Header (2)	Parameter (3)
Averaging Value	y	AVERage:COUNt	<nrf>
Calibration	y	*CAL?	
Capability	y	CAP?	
Clear Status	n	*CLS	
Configure Measurement	n	SENSe	<meas>(4)
Correction		CORRection	
A Value	y	CORRection:DATA:A	<nrf>
B Value	y	CORRection:DATA:B	<nrf>
Phase Value	y	CORRectio:PHASe	<nrf>
Normalize Impedance	y	CORRection:IMPedance	ON|OFF|1|0
Termination	y	CORRection:TERMination	ZO|SHORT|OPEN
Perform Normalization	n	CORRection:PERForm	
Normalization State	y	CORRection:STATe	ON|OFF|1|0
Direct Analog Output	y	DANalog	ON|OFF|1|0
Display State	y	DISPlay:STATe	ON|OFF|1|0
Fetch Results	y	FETCh?	
Continuous readings	y	FETCh:CONTinuous?	
Format	y	FORMat	LINear|LOGarithmic POLar|RECTangular| CARTesian
Frequency		FREQuency	
Band	y	FREQuency:BAND	<nrf>
Auto Ranging	y	FREQuency:BAND:AUTO	ON|OFF|1|0
Identification	y	*IDN?	
Input		INPut	
Impedance	y	INPut:IMPedance	<nrf>
Module Type	y	INPut:IMPedance:POD?	
Measure	y	MEASure?	<meas>{,<meas>}(4)
Timeout	y	MEASure:TIMEout	<nrf>
Timeout State	y	MEASure:TIMEout:STATe	ON|OFF|1|0
Output Test Signal	y	OUTPut	ON|OFF|1|0
Operation Complete	y	*OPC	
Reset	n	*RST	
Self Test	y	*TST?	
Service Request Enable	y	*SRE	<nrf> (5)
Standard Event Enable	y	*ESE	<nrf>
Standard Event Register	y	*ESR?	(6)
Status Byte Request	y	*STB?	
Status Control		STATus	
Operation Status		STATus:OPERation	
Condition Register	y	STATus:OPERation:CONDition?	(7)
Positive Transition Filter	y	STATus:OPERation:PTRansition	<nrf> (7)
Negative Transition Filter	y	STATus:OPERation:NTRansition	<nrf> (7)
Event Register	y	STATus:OPERation:EVENt?	
Enable Mask	y	STSTus:OPERation:ENABle	<nrf> (7)
System		SYSTem	
Error Register	y	SYSTem:ERRor?	NUMeric|STRing
Key	y	SYSTem:KEY	<nrf>
Format	y	SYSTem:FORMat	ASCii|FP64
Trigger	n	*TRG	
Trigger Setup		TRIGger	
Source	y	TRIGger:SOURce	BUS|FREErun
Wait-to-continue	n	*WAI	

NOTES

(1) Commands which allow a query option are indicated by "y". Commands where the query is mandatory are also shown with the query question mark in the Command Header column.

(2) Letters in CAPITALS are required. The remainder of the command can be added if desired for legibility.

(3) <nrf> indicates Numeric Representation Flexible, which is a forgiving real format described in IEEE 488.2.

(4) <meas> indicates AVOLtage|BVOLtage|APOWer|BPOWer|BA|PHASe|TRANsmission|
DELay|SWR|RHO|Y|Z|CORE

(5) Status Byte bit usage is as follows.

bit 4 Message Available
bit 5 Standard Event Summary Bit
bit 6 Request Service / Master Summary Status (MSS)
bit 7 Operation Status Register Summary Bit

Other bits are unused.

(6) Standard Event Status Register bit usage is as follows.

bit 0 Operation Complete
bit 2 Query Error
bit 3 Device Error
bit 4 Execution Error
bit 5 Command Error

Other bits are unused.

(7) Operation Status Register bit usage is as follows.

bit 0 Calibrating
bit 2 Ranging (Unlocked)
bit 3 Measuring
bit 4 Awaiting Trigger

Other bits are unused.

Refer to Figure 3-23 for an example of SRQ enabling and handling.

Command Reference

Commands which have no parallel in local operation are described fully in this section, and are indicated by the <=HP-IB=>logo in the header. Commands which operate instrument functions available from the front panel are described only briefly here, because full functional descriptions are given in the section describing local operation.

Averaging Value <=HPIB=> AVERage:COUNt <nrf>

When making measurements the Vector Voltmeter accumulates a number of internal readings and averages them to produce a result which is fed to the display and/or HP-IB. The averaging value can be changed only via HP-IB. The default is 2^5 measurements per reading. Higher values may reduce measurement variation , especially with noisy signals, at the cost of a lower measurement rate. Lower values increase the measurement rate and may increase measurement variation.

Range 0 to 10. Default 5. The number of internal readings made is two, raised to the power of AVERage:COUNt.

The query option returns the current setting.

Calibration *CAL?

Performs an internal device calibration. A value of 1 will be returned if the calibration fails. A value of 0 indicates successful calibration.

Capability <=HPIB=> CAPability?

Returns the instrument's HP-IB capability string as follows:

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2

Clear Status <=HPIB=> *CLS

Clears the contents of the status register and associated status data structures. This command should be used as part of remote instrument preset.

Configure Measurement SENSE <meas>

This command is used to configure the measurement that the Vector Voltmeter will make, and the results it will return in response to a measurement query. Default is AVOLtage.

Options for <meas> are listed in the **Measure** section.

Correction CORRection

		:DATA	
A Value	<=HPIB=>	:A	<nrf>
B Value	<=HPIB=>	:B	<nrf>
Phase Value	<=HPIB=>	:PHASe	<nrf>
Normalize Impedance		:IMPedance	ON|OFF|1|0
Termination		:TERMination	SHORT|OPEN|Z0
Perform Normalization		:PERForm	
Normalization State		:STATe	ON|OFF|1|0

The correction commands define the normalization values and state. Correction values can be sent to the Vector Voltmeter, impedance measurements can be normalized, current measurements can be saved as a reference and the normalization function can be switched on and off.

The default state is all correction off.

CORRection :DATA allows data to be sent to the Vector Voltmeter for use as a reference value. :A :B and :PHASe are used to define the destination of the reference value. The ability to use specific data as reference values is a function available only from HP-IB.

The query options return the current value.

CORRection :IMPedance sets the impedance normalization function. ON (1) sets the Vector Voltmeter to normalize impedance measurements. OFF (0) implies that impedance measurements are calculated from the current value of Input Impedance. The default is OFF.

The query option returns 1 or 0.

CORRection :TERMination sets the termination standard for reflection measurements. The default is SHORT.

The query option returns the current setting as an ASCII string.

CORRection :PERForm sets the :A :B and :PHASe references to be the current measurement values.

CORRection :STATe defines if the CORRECTION function is in use. It sets the normalization function to ON (1) or OFF (0). The default is OFF.

The query option returns 1 or 0.

Direct Analog Output DANalog ON|OFF|1|0

Sets the Vector Voltmeter to operate as a simple converter. The frequency and amplitude ranges are locked and the rear panel outputs represent the A or B voltage (depending on which is selected on the front panel) and the phase difference. No processing is carried out, nor are any results available over HP-IB. The mode is intended for use in applications such as narrowband swept testing of crystal filters.

The default is OFF.

The query option returns 1 or 0.

Display State <=HPIB=> `DISPlay:STATe ON|OFF|1|0`

Controls the front panel display. The display can be turned off when not needed. A speed improvement may be realized by switching the display off. The improvement will be greater as AVERAGE:COUNt is reduced , since updating the display is an overhead at the end of the measurement cycle.

The default is ON.

The query option returns 1 or 0.

Fetch Results <=HPIB=> `FETCh?`

`Continuous readings :CONTinuous?`

This query returns the result of the measurement most recently started as soon as it is available. The result will be generated using the current measurement configuration.

FETCh:CONTinuous? causes results to be passed to the HP-IB such that when one is read, the next is made available for reading as soon as it is calculated.

Format `FORMat LINear|LOGarithmic|POLar|RECTangular|CARTesian`

The format command sets the units in which measurement results will be returned.

LINear Sets voltage and power units to volts and watts respectively, and magnitude ratio to a dimensionless quantity.
LOGarithmic Sets voltage and power units to dBuV and dBm respectively, magnitude ratio to dB, and RHO magnitude to Return Loss in dB.
POLar Sets the results from vector measurements to ratio and phase angle.
RECTangular Sets the results from vector measurements to real and imaginary components.
CARTesian Identical to RECTangular.
The default is LINear POLar.

The query option returns an ASCII string indicating the current state.

Frequency FREQuency

```
Band                        :BAND <nrf>
Auto Ranging                :AUTO  ON|OFF|1|0
```

Sets the frequency band of the Vector Voltmeter lock circuits. The band may be set explicitly, or the Vector Voltmeter can be allowed to auto-range. It is recommended that explicit band selection is used when possible to minimise lock time.

FREQuency :BAND selects the frequency band explicitly. The command forces BAND:AUTO to OFF. Bands are as follows:

Band Number	Frequency band (MHz)	Band Number	Frequency Band (MHz)
1	0.1 to 0.2	9	25 to 50
2	0.2 to 0.6	10	50 to 80
3	0.6 to 1	11	80 to 150
4	1 to 3	12	150 to 250
5	3 to 5	13	250 to 500
6	5 to 8	14	500 to 1000
7	8 to 15	15	1000 to 2000
8	15 to 25	20	0.02 to 0.02

The default setting is automatic band selection.

The query option returns the current band.

FREQuency :BAND:AUTO selects explicit or automatic frequency band selection. Frequency band 20 will not be selected. When turned OFF the Vector Voltmeter remains in the current band.

The default is ON, but is forced to OFF when the FREQ:BAND command is received.

The query option returns 1 or 0.

Identification <=HPIB=> *IDN?

The identification command returns a string which describes the Vector Voltmeter and Input Module. The string contains four fields, separated by commas, as shown below.

```
          HEWLETT-PACKARD,8508A-050,0,REV 2944
          -------------- ---- -- - --------
                |          |    |  |    |
  Manufacturer --          |    |  |     - Firmware revision
                           |    |  |
             Model number --     |   -- (Not used)
                                  -- Input module option (STD or 050)
```

Input `INPut :IMPedance <nrf>`
`:POD?`

Input impedance sets the impedance of the measurement system, used in power and impedance measurements. Allowed values are 50 or 75 (Ohms).

The query option returns the current setting.

POD either 50, 75 or HI.

Measure `MEASure? <meas>{,<meas>}`

`Timeout :TIMEout <nrf>`
`:STATe ON|OFF|1|0`

This command is used to configure and make a Vector Voltmeter measurement (or measurements) and return the result(s). Default is AVOLtage.

Options for <meas> are listed below

```
AVOLtage      Channel A Voltage, using current setting of FORMat (LOG|LIN).
BVOLtage      Channel B Voltage, using current setting of FORMat (LOG|LIN).
APOWer        Channel A Power, using current settings of INPut:IMPedance and
              FORMat (LOG|LIN).
BPOWer        Channel B Power, using current settings of INPut:IMPedance and
              FORMat (LOG|LIN).
BA            B/A Magnitude Ratio, using current setting of FORMat (LOG|LIN).
PHASE         B-A Phase.
TRANsmission  B/A Magnitude Ratio and B-A Phase, computed from the same
              measurement, using current settings of FORMAT (LOG|LIN and POL|RECT).
DELay         Delay
SWR           Standing Wave Ratio
RHO           Reflection Coefficient, using current settings
              FORMat (LOG|LIN and POL|RECT).
Y             Admittance (1/Z), using current settings of INPut:IMPedance and
              FORMAT (POL|RECT).
Z             Impedance, using current settings of INPut:IMPedance and
              FORMAT (POL|RECT).
CORE          All basic measurements - AVOLtage, BVOLtage and PHASe.
              Equivalent to MEAS? AVOL,BVOL,PHASE.

MEASure :TIMEout allows the measurement to timeout if the instrument has not locked
to a signal. The range of the timeout is 0 to 30 seconds. The default is 30 seconds.

MEASure :TIMEout: STATe defines if the timeout function is in use. It sets the timeout
function to ON (1) or OFF (0).

The query option returns 1 or 0.
```

All the above measurements are also dependant on whether CORRection:STATe is ON or OFF.

Output `OUTPut ON|OFF|1|0`

Controls the front panel Test output signal.

The default is OFF.

The query option returns 1 or 0.

Operation Complete `<=HPIB=> *OPC`

This command causes the Operation Complete bit in the Standard Event Status Register to be set when the Vector Voltmeter has completed all pending operations.

The Standard Event Status Register can be monitored to find when the bit is set using the *ESR? command, or the Vector Voltmeter can be set to request service when the bit is set true.

The query option returns "1" when all pending operations have been completed.

Reset `<=HPIB=>` `*RST`

The reset function sets the Vector Voltmeter to a front panel state the same as using the PRESET key. It has no effect on the status registers or results waiting to be read.

Self Test `*TST?`

This command initiates an instrument self test and causes a result to be output. The result will be zero (0) if the test is completed without errors. A one (1) indicates an error has occurred. Full details of the error codes appear in the Troubleshooting section of this Manual.

Service Request Enable `<=HPIB=> *SRE <nrf>`

Sets the service request conditions.

Status Byte bit usage is as follows.

bit 4 Message Available
bit 5 Standard Event Status Register summary bit
bit 7 Operation Status Register summary bit

Other bits are unused.

The query option returns the currently selected conditions.

Standard Event Status Enable `*ESE <nrf>`

Sets the Standard Event Register mask conditions.

The query option returns the currently selected conditions. Range 0 through 255, using encoding as in Table 3-2.

Standard Event Status Register `*ESR?`

Returns and Clears the current value of the Standard Event Status Register.

Status Byte Query `*STB?`

Returns the current value of the Status Byte, with Master Summary Status (MSS) as bit 6. The Byte consists of bits which summarise each Status Reporting Structure. Bits are cleared by clearing the related structure.

Status Control `<=HPIB=>  STATus`

```
Operation Status                :OPERation
Condition Register              :CONDition?
Positive Transition Filter      :PTRansition <nrf>
Negative Transition Filter      :NTRansition <nrf>
Event Register                  :EVENt?
Enable Mask                     :ENABLE <nrf>
```

The status command controls the setup and operation of the condition and event registers. The registers are set by positive or negative transitions of the appropriate condition, enabled by transition filters.

EVENt? and CONDition? return the current values of the corresponding registers.

ENABle selects which events latched using the Positive TRansition and Negative TRansition filters, are reported in the Status Byte summary bit 7.

The query option of ENABle returns 0 through 255, using encoding as in Table 3-2.

The query options of PTRansition and NTRansition return the current transition masks.

System `SYSTem`

```
Error Register      :ERRor? NUMeric|STRing
Key                 :KEY    <nrf>
Format              :FORMat ASCii|FP64
```

The system command covers miscellaneous housekeeping and global activities in the Vector Voltmeter.

SYSTem:ERRor ? returns an error code describing any error that occurs. Errors are returned as either numeric responses or as a string describing the error. By default a string is returned. Full details of the error codes appear in the Troubleshooting section of this Manual.

SYSTem:KEY allows direct programming of the front panel key functions to simulate key presses. Each key is simulated by sending its keycode given in Table 3-3.

The query option returns the code of the last key pressed.

Table 3-3. Keycodes

Keycode	Description
1	A
2	B
3	REFL MEAS
4	FORMAT
5	POWER MEAS
6	B/A MAG
7	B-A PHASE
8	REF SELECT
9	REF
10	SYSTEM IMPD
11	METER SELECT
12	LOCK RANGE
13	STEP UP
14	STEP DOWN
15	MAG RANGE
16	HOLD VALUE
17	DISPLAY
18	SHIFT
19	LCL
20	PRESET

SYSTem:FORMat sets the HP-IB output format for measurement results. Two formats are available (ASCii and FP64) and they are described in the earlier section on HP-IB Response Formats.

Trigger <=HPIB=> *TRG

The trigger command performs the same function as the Group Execute Trigger command defined by IEEE 488.1, that is it initiates a new measurement when the TRIGger:SOURce is BUS.

Trigger Setup <=HPIB=> TRIGger

Source :SOURce BUS|FREErun

The trigger setup function allows the trigger mode to be selected. In freerun, the Vector Voltmeter makes measurements as quickly as possible. When the trigger source is set to BUS, the Vector Voltmeter waits to receive a trigger before initiating the next measurement.

Wait-to-continue <=HPIB=> *WAI

This command causes the Vector Voltmeter to complete all current actions before accepting any more commands. It can be used to synchronize the instrument's operation with other equipment.

Performance Tests

Section 4

4-1 INTRODUCTION

As the HP Model 8508A mainframe cannot be performance tested without a Probe Module installed, the full performance test information is contained in Section 4 of the Input Module insert.

Adjustments Section 5

5-1 INTRODUCTION

This section describes the adjustment procedures required to enable the Hewlett-Packard 8508A Vector Voltmeter to meet the specifications listed in Table 1-2 of the Probe Input Module manual. Adjustments should only be made after determining that the instrument is out of calibration or if a repair has been carried out.

5-2 WARM-UP TIME

The HP 8508A must be switched on for a minimum of 30 minutes before carrying out any adjustments. This allows the instrument operating temperature to stabilize.

5-3 SAFETY CONSIDERATIONS

WARNING

PROCEDURES DESCRIBED IN THIS SECTION ARE PERFORMED WITH THE PROTECTIVE COVERS REMOVED AND POWER SUPPLIED TO THE INSTRUMENT. SERVICING SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED.

Anti-Static Precautions

The printed circuit boards contained in this instrument have components and devices which are susceptible to damage by electrostatic discharge (ESD). To minimize the risks of damaging or decreasing the reliability of the instrument, the following procedures and cautions should be observed when servicing the instrument.

Static-free Workstation

All servicing should be carried out at a static-free workstation wherever practical.

De-soldering

When de-soldering components, ensure that the soldering iron is grounded. Always use a metalized solder remover.

Anti-Static Freezer Spray

When attempting to locate a temperature related fault, use only an approved anti-static freezer spray.

Anti-Static Products

Table 5-1 contains details of anti-static products which are available from Hewlett-Packard.

Table 5-1. Anti-Static Products

Product	HP Part Number
Anti-static workstation kit	9300-0792
Metalized Solder Remover	8690-0227
Wrist-strap and cord	9300-0970

5-4 EQUIPMENT REQUIRED

All adjustment procedures contain a list of required test equipment. The test equipment is also identified by callouts in the test setup diagrams, where included. If substitutions must be made for the specified test equipment, refer to the Recommended Test Equipment table in section 1 of this manual for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table if the Vector Voltmeter is to meet its performance requirements.

Note: Use a non-metallic tool whenever possible (for example, HP Part Number 8830-0024).

5-5 POST REPAIR ADJUSTMENTS

Table 5-2 lists the adjustments related to repairs or replacement of any of the assemblies.

5-6 RELATED ADJUSTMENTS

Table 5-2. Related Adjustments

Assembly Replaced	Perform the following Adjustments
A1 Front Panel.	None.
A2 Power Supply.	5-8.
A3 IF Assembly.	5-9.
A4 Search & Lock.	5-10.
A5 Processor.	None.

5-7 ADJUSTABLE COMPONENTS

Table 5-3 lists all adjustable components in the HP 8508A Vector Voltmeter.

Table 5-3. Adjustable Components

Reference Designation	Adjustment Name	Adjustment Paragraph	Description.
A2 R 11	+ 5.0 V	5-8	Adjusts the + 5.0V REG Supply.
A2 R 16	+12.0 V	5-8	Adjusts the +12.0V REG Supply.
A2 R 19	-12.0 V	5-8	Adjusts the -12.0V REG Supply.
A3 L 1	Set 20 kHz Ch A	5-9	Sets centre frequency of bandpass filter.
A3 L 2	Set 20 kHz Ch B	5-9	Sets centre frequency of bandpass filter.
A3 R151	Differential Phase	5-9	Sets ±180° phase range on A3.
A3 R178	100 mV Ref.	5-9	Absolute gain adjustment.
A4 R 89	Set 1.62 MHz	5-10	RC -- VCO centre frequency.
A4 L 3	Set 32.4 MHz	5-10	LC -- VCO centre frequency.

5-8 POWER SUPPLY ADJUSTMENTS: +12.0V, -12.0V and +5.0V.

DESCRIPTION

The +12.0V, -12.0V, and + 5.0V power supplies are adjusted under load for the proper voltage levels with an Input Module installed.

EQUIPMENT

Instrument	Recommended Model
Input Module	HP 85081A or HP 85082A
Digital Voltmeter (DVM)	HP 3456A

PROCEDURE:

1. Install an Input Module in the HP 8508A mainframe.

2. Switch on the equipment and allow to warm up for 30 minutes.
   NOTE: If an Error Code in the 200 Series is displayed, the power supply voltages should be tested with a DVM. If the supply voltages are correct, the fault may be on the Search and Lock Asssembly (A4).

3. Remove the HP 8508A top cover to allow access to the adjustments.

4. Connect the DVM input to the Test Points shown in the following table and make the appropriate adjustments for the correct voltage levels.

Test Point	Adjustment	Voltage	Tolerance
A2 TP3	A2R16	+12.0V	±0.1V
A2 TP4	A2R19	-12.0V	±0.1V
A2 TP2	A2R11	+ 5.0V	±0.05V
A2 TP1		GND	

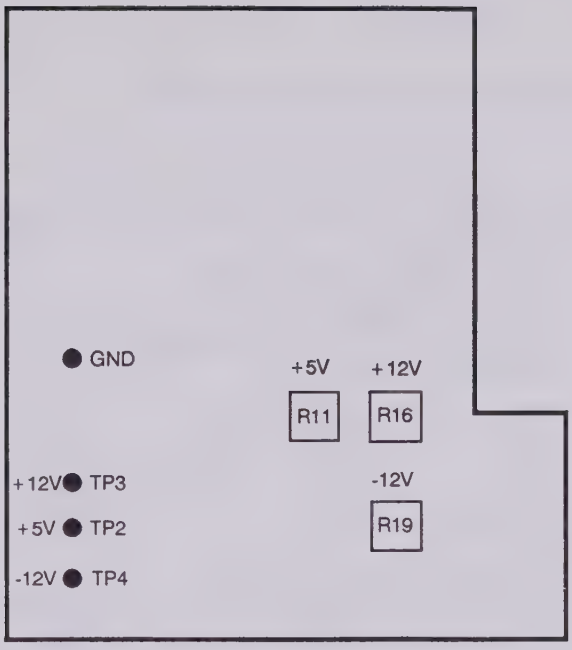

Figure 5-1. Power Supply Adjustment Locations

5. Replace the HP 8508A top cover.

5-9 IF ASSEMBLY ADJUSTMENTS

Set up the centre frequency of the Channel A and B Bandpass filters.

DESCRIPTION

The 20 kHz centre frequency for Channel A and B is set up using an internal test routine.

EQUIPMENT

No external test equipment is required for this adjustment.

PROCEDURE

1. Remove the Input Module from the instrument.

2. Switch on the equipment and allow to warm up for 30 minutes.
   Note: Since the Input Module is not installed in the mainframe, the HP 8508A will display the error message "Err 601". This reading should be ignored.

3. Remove the HP 8508A top cover to allow access to the adjustments.

4. Adjust the cores of A3L1 and A3L2 to the top of the coils.

5. Select [PRESET] [SHIFT] [POWER MEAS] to put the instrument into the 'setup' mode. The Displays will now indicate which setup code is being used. This will appear as:
   tSt nnnn

   tSt indicates that the instrument is in the 'setup'mode and '**nnnn**' is the current setup code.

   Use the UP/DOWN 'Arrow' keys to set up test code '2' in Display 2.

   Press [HOLD VALUE] and check that the indicator LED is ON.

6. Adjust the A3L1 core to obtain a maximum reading in Display 2.

7. Press [HOLD VALUE] to cancel the function.

8. Use the UP/DOWN 'Arrow' keys to set up test code '3' in Display 2.

   Press [HOLD VALUE] and check that the indicator LED is ON.

9. Adjust the core of A3L2 to obtain a maximum reading on Display 2.

10. Press [HOLD VALUE] to cancel the function.

11. Replace the HP 8508A top cover.

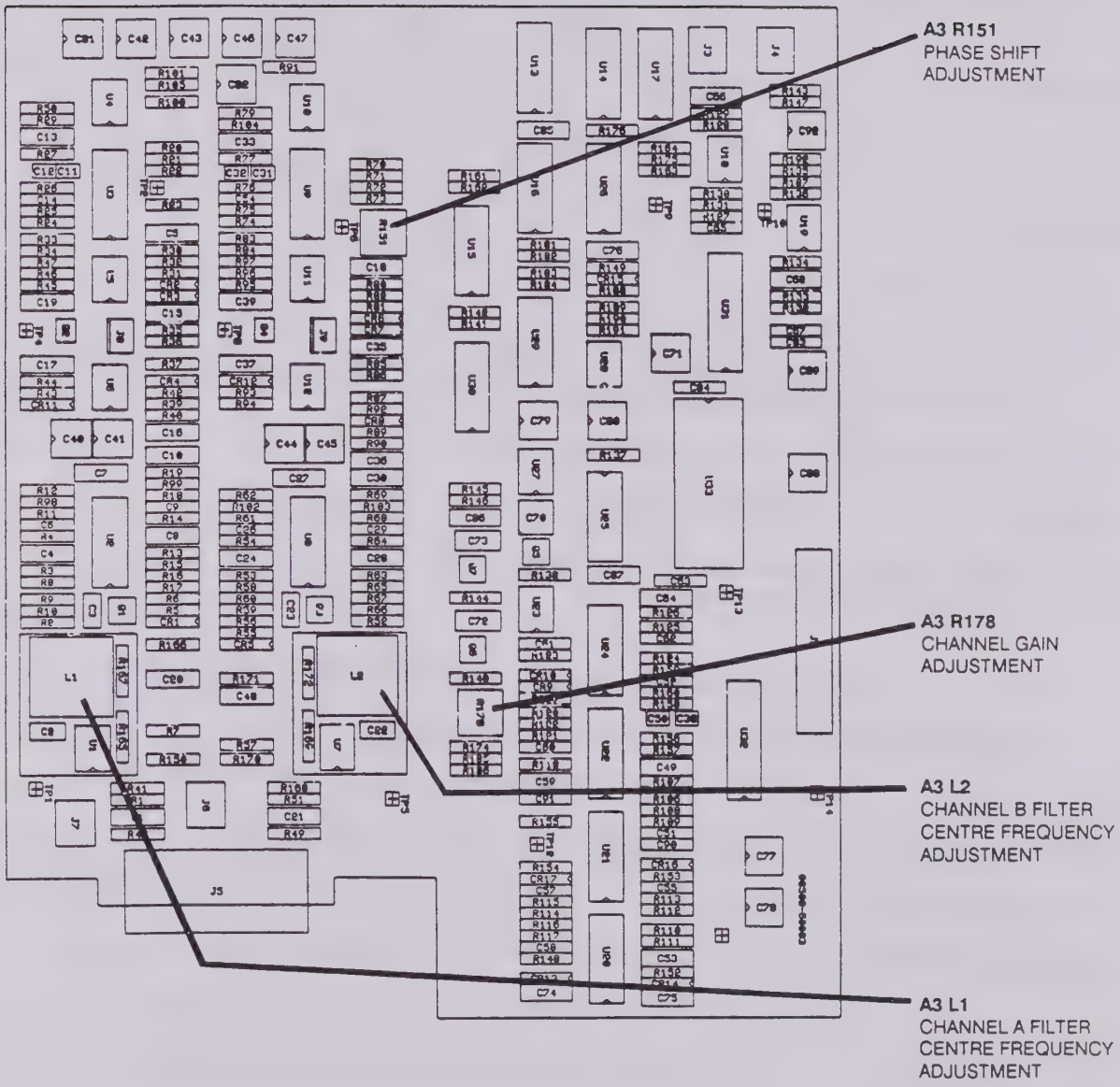

Figure 5-2. IF Assembly Component Location

To equalize the A and B Channel phase shift.

DESCRIPTION

An internal test routine is used for this adjustment.

EQUIPMENT

No external test equipment is required for this adjustment.

PROCEDURE

1. Remove the Input Module from the instrument.

2. Switch on the equipment and allow to warm up for 30 minutes.
   Note: Since the Input Module is not installed in the mainframe, the HP 8508A will display the error message "Err 601". This reading should be ignored.

3. Remove the HP 8508A top cover to allow access to the adjustments.

4. Set A3R151 fully counter-clockwise.

5. Select [PRESET] [SHIFT] [POWER MEAS] to put the instrument into the 'setup' mode. The Display will now indicate which setup code is being used. It will appear as:
   tSt nnnn

   tSt indicates that the instrument is in the 'setup'mode and **'nnnn'** is the current setup code.

   Use the UP/DOWN 'Arrow' keys to set up test code '4' in Display 2.

   Press [HOLD VALUE] and check that the indicator lamp is illuminated.

6. Adjust A3R151 to obtain a zero reading in Display 2.

7. Press [HOLD VALUE] to cancel the function.

8. Replace the HP 8508A top cover.

Set up the amplitude path gain using an external 20kHz, 100 mV reference source.

DESCRIPTION

To ensure interchangeability of Input Modules the 100 mV level at the module interface must be accurately set.

Figure 5-3. Reference Level Adjustment Equipment Setup

EQUIPMENT

Instrument	Recommended Model
AC Calibrator	Datron 4200A

PROCEDURE

1. Remove the Input Module from the instrument.

2. Switch on the equipment and allow to warm up for 30 minutes.
   Note: Since the Input Module is not installed in the mainframe, the HP 8508A will display the error message "Err 601". This reading should be ignored.

3. Select [PRESET] [SHIFT] [POWER MEAS] to put the instrument into the 'setup' mode. The Display will now indicate which setup code is being used. It will appear as:
   tSt nnnn

   tSt indicates that the instrument is in the 'setup'mode and '**nnnn**' is the current setup code.

   Use the UP/DOWN 'Arrow' keys to set up test code '5' in Display 2.

   Press [HOLD VALUE] and check that the indicator lamp is illuminated.

4. Remove the HP 8508A top cover to allow access to the adjustments.

5. Configure the equipment as shown in the Figure 5-3.

   In this test, a 100mV signal from the AC Calibrator is applied simultaneously to the Channel A and Channel B Input Amplifiers on the IF board. A pair of miniature probe clips should be used to apply this signal between A3C1 and A3R150 for Channel A, and between A3C21 and A3R170 for Channel B. The location of these points is shown in Figure 5-4.

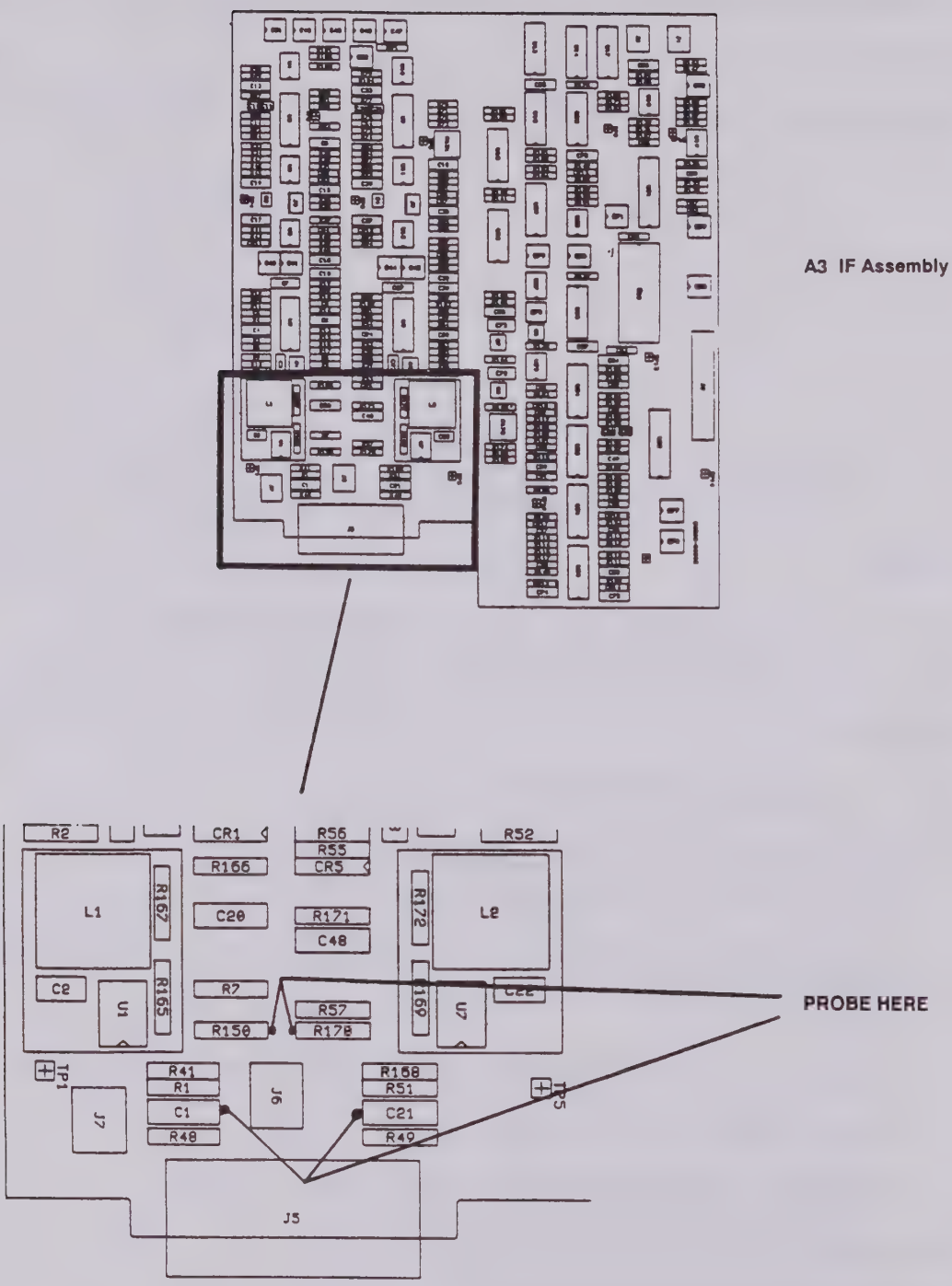

Figure 5-4. IF Measurement Assembly Test Point Locations

Alternatively, install the input module extender (HP part number 08508-60032) in the HP 8508A Vector Voltmeter. (The input module is not required.) Set switch S1 on the input module extender to 'CALIBRATION' and set switch S2 to 'EXTENDER:CALIBRATION'. The 100mV signal from the AC Calibrator can be applied to either of the BNC connectors on the input module extender front panel.

6. Set up the AC Calibrator for an output frequency of 20 kHz and a level of 100 mV.

7. Adjust A3R178 to give a display reading of 100.0 ± 0.1 on Display 2.

8. Press [HOLD VALUE] to cancel the function.

9. Remove the test clips and replace the HP 8508A top cover.

5-10 SEARCH & LOCK ASSEMBLY ADJUSTMENTS

Set up the centre frequency of the 1.62 MHz and 32.4MHz Oscillators.

DESCRIPTION

The centre frequencies are set up using an internal test routine.

EQUIPMENT

No external test equipment is required for this adjustment.

PROCEDURE

1. Remove the Input Module from the instrument.

2. Switch on the equipment and allow to warm up for 30 minutes.
   Note: Since the Input Module is not installed in the mainframe, the HP 8508A will display the error message "Err 601". This reading should be ignored.

3. Remove the HP 8508A top cover to allow access to the adjustments.

4. Select [PRESET] [SHIFT] [POWER MEAS] to put the instrument into the 'setup' mode
The Display will now indicate which setup code is being used. It will appear as:
   tSt nnnn

   tSt indicates that the instrument is in the 'setup' mode and '**nnnn**' is the current setup code.

   Use the UP/DOWN 'Arrow' keys to set up test code '0' in Display 2.

   Press [HOLD VALUE] and check that the indicator LED is ON.

5. Adjust A4R89 slowly until the UNLOCK light extinguishes.
   Note: The green LED (CR6), across the board from A4R89, is functionally the same as the UNLOCK light on the front panel.

6. Press [HOLD VALUE] to cancel the function.

7. Use the UP/DOWN 'Arrow' keys to set up test code '2' in Display 2.
   Press [HOLD VALUE] and check that the indicator LED is ON.

8. Adjust the core of A4L3 slowly until the UNLOCK light extinguishes.

9. Press [HOLD VALUE] to cancel the function.

10. Replace the HP 8508A top cover.

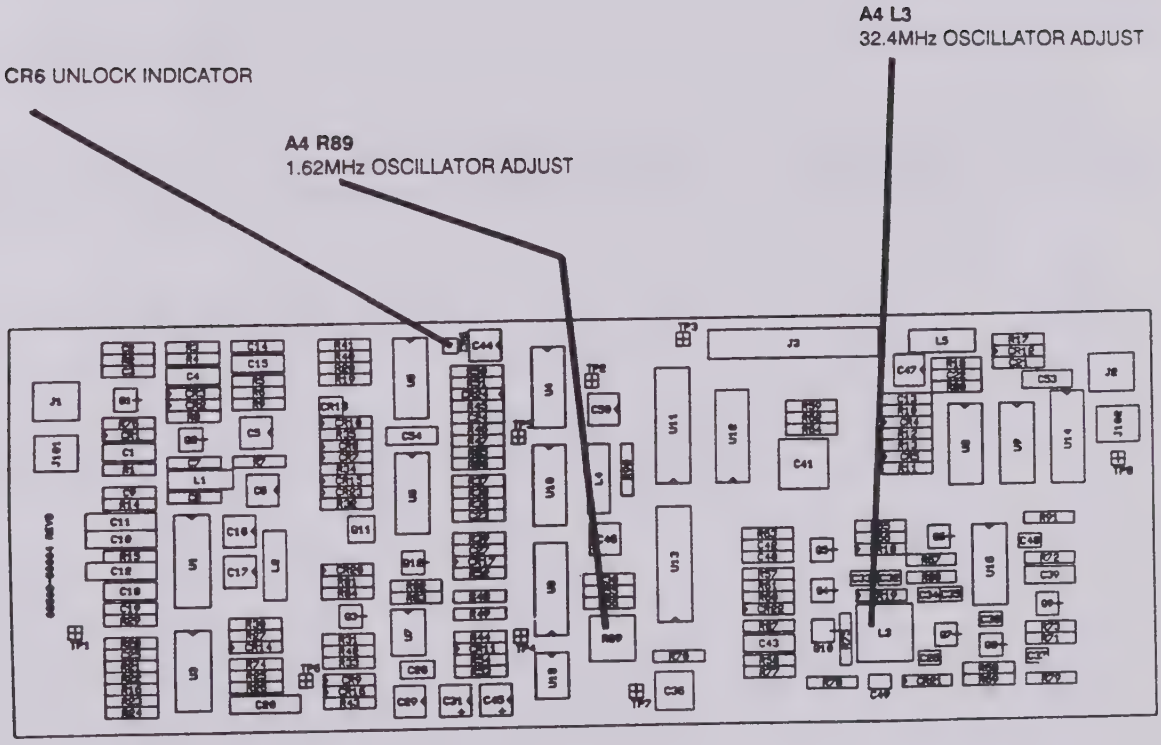

Figure 5-5. Search and Lock Assembly Adjustment Locations

Replaceable Parts Section 6

6-1 INTRODUCTION

This section contains information for ordering parts. Table 6-2 lists the abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order and Table 6-4 lists the names and addresses that correspond to the manufacturer's code number used in the parts list. Figures 6-1 to 6-3 illustrate the chassis mounted parts, miscellaneous parts and assembly information.

6-2 ABBREVIATIONS

Table 6-2 lists all the abbreviations used in the parts lists and throughout the manual. In some cases, two forms of an abbreviation are given, one in all capital letters and the other in partial or no capital letters. This is because the abbreviations used in the parts list are always all capitals; however, in other parts of the manual, abbreviations are used in partial or no capital letters.

6-3 REPLACEABLE PARTS LIST

Table 6-3 is organized as follows:

(a) Electrical assemblies and their components in alpha-numeric order followed by reference designation.
(b) Chassis-mounted parts in alpha-numeric order by reference designation.
(c) Miscellaneous parts.

The information given for each part consists of the following:

(a) The Hewlett-Packard part number.
(b) Part number check digit (CD).
(c) The total quantity (QTY) in the instrument.
(d) The description of the part.
(e) A typical manufacturer of the part (in a five-digit code).
(f) The manufacturer's part number for that part.

The total quantity for each part is given only once - at the first appearance of the part in the list.

6-4 ORDERING INFORMATION

To order a part listed in the replaceable parts list table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the Replaceable Parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-5 DIRECT MAIL ORDER SYSTEM

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

(a) Direct ordering and shipment from the HP Parts Centre in Mountain View, California.

(b) No maximum or minimum order value on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

(c) Prepaid transportation (there is a small handling charge for each order).

(d) No invoices - to provide these advantages, a cheque or money order must accompany each order.

Mail order forms and specific ordering information are available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designations

REFERENCE DESIGNATIONS

A	assembly	E	miscellaneous electrical part	P	electrical connector (movable portion); plug	U	integrated circuit; microcircuit
AT	attenuator; isolator; termination	F	fuse	Q	transistor; SCR; triode thyristor; FET	V	electron tube
B	fan; motor	FL	filter	R	resistor	VR	voltage regulator; breakdown diode
BT	battery	H	hardware	RT	thermistor	W	cable; transmission path; wire
C	capacitor	HY	circulator	S	switch	X	socket
CP	coupler	J	electrical connector (stationary portion); jack	T	transformer	Y	crystal unit (piezo-electric or quartz)
CR	diode; diode thyristor; varactor	K	relay	TB	terminal board	Z	tuned cavity; tuned circuit
DC	directional coupler	L	coil; inductor	TC	thermocouple		
DL	delay line	M	meter	TP	test point		
DS	annunciator; signaling device (audible or visual); lamp; LED	MP	miscellaneous mechanical part				

Table 6-2. Abbreviations (1 of 2)

ABBREVIATIONS

A	ampere	COEF	coefficient	EDP	electronic data processing	INT	internal
ac	alternating current	COM	common	ELECT	electrolytic	kg	kilogram
ACCESS	accessory	COMP	composition	ENCAP	encapsulated	kHz	kilohertz
ADJ	adjustment	COMPL	complete	EXT	external	k	kilohm
A/D	analog-to-digital	CONN	connector	F	farad	kV	kilovolt
AF	audio frequency	CP	cadmium plate	FET	field-effect transistor	lb	pound
AFC	automatic frequency control	CRT	cathode-ray tube	F/F	flip-flop	LC	inductance-capacitance
AGC	automatic gain control	CTL	complementary transistor logic	FH	flat head	LED	light-emitting diode
AL	aluminum	CW	continuous wave	FIL H	fillister head	LF	low frequency
ALC	automatic level control	cw	clockwise	FM	frequency modulation	LG	long
AM	amplitude modulation	cm	centimeter	FP	front panel	LH	left hand
AMPL	amplifier	D/A	digital-to-analog	FREQ	frequency	LIM	limit
APC	automatic phase control	dB	decibel	FXD	fixed	LIN	linear taper (used in parts list)
ASSY	assembly	dBm	decibel referred to 1 mW	g	gram	LK WASH	lock washer
AUX	auxiliary	dc	direct current	GE	germanium	LO	low; local oscillator
avg	average	deg	degree (temperature interval or difference)	GHz	gigahertz	LOG	logarithmic taper (used in parts list)
AWG	American wire gauge	...°	degree (plane angle)	GL	glass	log	logarithm(ic)
BAL	balance	°C	degree Celsius (centigrade)	GRD	ground(ed)	LPF	low pass filter
BCD	binary coded decimal	°F	degree Fahrenheit	H	henry	LV	low voltage
BD	board	°K	degree Kelvin	h	hour	m	meter (distance)
BECU	beryllium copper	DEPC	deposited carbon	HET	heterodyne	mA	milliampere
BFO	beat frequency oscillator	DET	detector	HEX	hexagonal	MAX	maximum
BH	binder head	diam	diameter	HD	head	M	megohm
BKDN	breakdown	DIA	diameter (used in parts list)	HDW	hardware	MEG	meg (10^6) (used in parts list)
BP	bandpass	DIFF AMPL	differential amplifier	HF	high frequency	MET FLM	metal film
BPF	bandpass filter	div	division	HG	mercury	MET OX	metallic oxide
BRS	brass	DPDT	double-pole, double-throw	HI	high	MF	medium frequency; microfarad (used in parts list)
BWO	backware-wave oscillator	DR	drive	HP	Hewlett-Packard	MFR	manufacturer
CAL	calibrate	DSB	double sideband	HPF	high pass filter	mg	milligram
ccw	counter-clockwise	DTL	diode transistor logic	HR	hour (used in parts list)	MHz	megahertz
CER	ceramic	DVM	digital voltmeter	HV	high voltage	mH	millihenry
CHAN	channel	ECL	emitter coupled logic	Hz	Hertz	mho	mho
cm	centimeter	EMF	electromotive force	IC	integrated circuit	min	minute (time)
CMO	cabinet mount only			ID	inside diameter	...	minute (plane angle)
COAX	coaxial			IF	intermediate frequency	MINAT	miniature
				IMPG	impregnated	mm	millimeter
				in	incandescent		
				INCL	include(s)		
				INP	input		
				INS	insulation		

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Abbreviations (2 of 2)

MOD ..... modulator
MOM ..... momentary
MOS ..... metal-oxide semiconductor
ms ..... millisecond
MTG ..... mounting
MTR ..... meter (indicating device)
mV ..... millivolt
mVac ..... millivolt, ac
mVdc ..... millivolt, dc
mVpk ..... millivolt, peak
mVp-p ..... millivolt, peak-to-peak
mVrms ..... millivolt, rms
mW ..... milliwatt
MUX ..... multiplex
MY ..... mylar
μA ..... microampere
μF ..... microfarad
μH ..... microhenry
μmho ..... micromho
μs ..... microsecond
μV ..... microvolt
μVac ..... microvolt, ac
μVdc ..... microvolt, dc
μVpk ..... microvolt, peak
μVp-p ..... microvolt, peak-to-peak
μVrms ..... microvolt, rms
μW ..... microwatt
nA ..... nanoampere
NC ..... no connection
N/C ..... normally closed
NE ..... neon
NEG ..... negative
nF ..... nanofarad
NI PL ..... nickel plate
N/O ..... normally open
NOM ..... nominal
NORM ..... normal
NPN ..... negative-positive-negative
NPO ..... negative-positive zero (zero temperature coefficient)
NRFR .... not recommended for field replacement
NSR ..... not separately replaceable
ns ..... nanosecond
nW ..... nanowatt
OBD .... order by description
OD ..... outside diameter
OH ..... oval head
OP AMPL ..... operational amplifier
OPT ..... option
OSC ..... oscillator
OX ..... oxide
oz ..... ounce
Ω ..... ohm
P ..... peak (used in parts list)
PAM ..... pulse-amplitude modulation
PC ..... printed circuit
PCM .... pulse-code modulation; pulse-count modulation
PDM ..... pulse-duration modulation
pF ..... picofarad
PH BRZ ... phosphor bronze
PHL ..... Phillips
PIN ..... positive-intrinsic-negative
PIV .... peak inverse voltage
pk ..... peak
PL ..... phase lock
PLO .... phase lock oscillator
PM ..... phase modulation
PNP ..... positive-negative-positive
P/O ..... part of
POLY ..... polystyrene
PORC ..... porcelain
POS ..... positive; position(s) (used in parts list)
POSN ..... position
POT ..... potentiometer
p-p ..... peak-to-peak
PP ..... peak-to-peak (used in parts list)
PPM ..... pulse-position modulation
PREAMPL ..... preamplifier
PRF ..... pulse-repetition frequency
PRR .... pulse repetition rate
ps ..... picosecond
PT ..... point
PTM ..... pulse-time modulation
PWM ..... pulse-width modulation
PWV ..... peak working voltage
RC ..... resistance-capacitance
RECT ..... rectifier
REF ..... reference
REG ..... regulated
REPL ..... replaceable
RF ..... radio frequency
RFI ..... radio frequency interference
RH ... round head; right hand
RLC ..... resistance-inductance-capacitance
RMO ..... rack mount only
rms ..... root-mean-square
RND ..... round
ROM ..... read-only memory
R&P ..... rack and panel
RWV ..... reverse working voltage
S ..... scattering parameter
s ..... second (time)
... " ..... second (plane angle)
S-B ..... slow-blow (fuse) (used in parts list)
SCR ..... silicon controlled rectifier; screw
SE ..... selenium
SECT ..... sections
SEMICON .... semiconductor
SHF .... superhigh frequency
SI ..... silicon
SIL ..... silver
SL ..... slide
SNR .... signal-to-noise ratio
SPDT ..... single-pole, double-throw
SPG ..... spring
SR ..... split ring
SPST ..... single-pole, single-throw
SS ..... Service Sheet
SSB ..... single sideband
SST ..... stainless steel
STL ..... steel
SQ ..... square
SWR .... standing-wave ratio
SYNC ..... synchronize
T ..... timed (slow-blow fuse)
TA ..... tantalum
TC ..... temperature compensating
TD ..... time delay
TERM ..... terminal
TFT ..... thin-film transistor
TGL ..... toggle
THD ..... thread
THRU ..... through
TI ..... titanium
TOL ..... tolerance
TRIM ..... trimmer
TSTR ..... transistor
TTL ..... transistor-transistor logic
TV ..... television
TVI .... television interference
TWT .... traveling wave tube
U ..... micro (10^{-6}) (used in parts list)
UF ..... microfarad (used in parts list)
UHF ..... ultrahigh frequency
UNDEF ..... undefined
UNREG ..... unregulated
V ..... volt
VA ..... voltampere
Vac ..... volts, ac
VAR ..... variable
VCO ..... voltage-controlled oscillator
Vdc ..... volts, dc
VDCW .... volts, dc, working (used in parts list)
V(F) ..... volts, filtered
VFO ..... variable-frequency oscillator
VHF ..... very-high frequency
Vpk ..... volts, peak
Vp-p ..... volts, peak-to-peak
Vrms ..... volts, rms
VSWR ..... voltage standing wave ratio
VTO ..... voltage-tune oscillator
VTVM ..... vacuum-tube voltmeter
V(X) ..... volts, switched
W ..... watt
W/ ..... with
WIV ..... working inverse voltage
WW ..... wirewound
W/O ..... without
YIG ..... yttrium-iron-garnet
Z_o ..... characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-3. Replaceable Parts

FRONT PANEL ASSEMBLY

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
A1					
A1	08508-60001	2	1	FRONT PANEL ASSEMBLY	E6006000
A1	08508-60101	3	1	FRONT PANEL ASSEMBLY (supplied without Display LED set 08508-60020)	E6006000
	08508-60020	5	1	BUNDLED DISPLAY PACKAGE Note: The LED's marked (*) are available as a set (HP Part Number 08508-60020). This set has been selected for intensity matching. Should any LED failures occur, it is recommended that the set be replaced to maintain intensity integrity. Individual LED's can be replaced. However, no guarantee can be given that the replacement items will match the intensity level of the existing set.	E6006000
DS 01	* HDSP-4606	0	1	UNIVERSAL OVERFLOW +-1	E6006000
DS 02	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 03	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 04	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 05	* HLMP-2802	2	1	LIGHT BAR QUAD	E6006000
DS 06	* HLMP-2820	2	1	LIGHT BAR QUAD	E6006000
DS 07	* HDSP-4606	0	1	UNIVERSAL OVERFLOW +-1	E6006000
DS 08	* HLMP-2855	3	1	LIGHT BAR	E6006000
DS 09	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 10	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 11	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 12	* HDSP-4600	4	1	COM ANODE LH DECIMAL	E6006000
DS 13	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 14	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 15-23	HLMP-1840	4	9	SINGLE POINT	E6006000
DS 24	* HLMP-2350	3	1	LIGHT BAR SINGLE (RED)	E6006000
DS 25	* HLMP-2820	2	1	LIGHT BAR QUAD	E6006000
DS 26	* HLMP-2820	2	1	LIGHT BAR QUAD	E6006000
DS 27	* HLMP-2800	8	1	LIGHT BAR DOUBLE	E6006000
DS 28	* HLMP-2855	3	1	LIGHT BAR	E6006000
DS 29	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 30	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 31	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 32	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 33	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
DS 34	* HLMP-2500	5	1	LIGHT BAR SINGLE (GREEN)	E6006000
DS 35	* HLMP-2855	3	1	LIGHT BAR	E6006000
DS 36	* HDSP-4850	6	1	10 ELEMENT BAR GRAPH ARRAY	E6006000
DS 37	* HDSP-4850	6	1	10 ELEMENT BAR GRAPH ARRAY	E6006000
DS 38	* HDSP-4850	6	1	10 ELEMENT BAR GRAPH ARRAY	E6006000
DS 39-47	HLMP-1840	4	9	SINGLE POINT	E6006000
DS 48-61	HLMP-1840	4	14	SINGLE POINT	E6006000
DS 62	* HLMP-2300	3	1	LIGHT BAR LEGEND	E6006000
DS 63	* HLMP-2300	3	1	LIGHT BAR LEGEND	E6006000
MP 01	5041-4722	4	1	KEYCAP A	E6006000
MP 02	5041-4723	5	1	KEYCAP B	E6006000
MP 03	5041-4719	9	1	KEYCAP REFL MEAS	E6006000
MP 04	5041-4717	7	1	KEYCAP FORMAT	E6006000
MP 05	5041-4721	3	1	KEYCAP POWER MEAS	E6006600
MP 06	5041-4724	6	1	KEYCAP B/A MAG	E6006000
MP 07	5041-4725	7	1	KEYCAP B-A PHASE	E6006000
MP 08	5041-4720	2	1	KEYCAP REF SEL	E6006000
MP 09	5041-4716	6	1	KEYCAP REF	E6006000
MP 10	5041-4718	8	1	KEYCAP SYS IMP	E6006000
MP 11	5041-4712	2	1	KEYCAP METER SEL	E6006000
MP 12	5041-4713	3	1	KEYCAP LOCK RANGE	E6006000
MP 13	5041-4711	1	1	KEYCAP ARROW	E6006000
MP 14	5041-4711	1	1	KEYCAP ARROW	E6006000
MP 15	5041-4714	4	1	KEYCAP MAG RANGE	E6006000
MP 16	5041-4715	5	1	KEYCAP HOLD VALUE	E6006000
MP 17	5041-0982	0	1	KEYCAP DISPLAY	E6006000
MP 18	5041-0432	5	1	KEYCAP SHIFT	E6006000
MP 19	5041-4710	0	1	KEYCAP LCL	E6006000
MP 20	5041-4709	7	1	KEYCAP PRESET	E6006000
A1SW1-20	3101-2409	6	20	SW-PB SPST NO	E6006000
A1W1	08508-60010	3	1	CABLE A1 TO A5	E6006000
	08508-60020	5	1	BUNDLED DISPLAY PACKAGE CONSISTS OF THE FOLLOWING:	E6006000
DS 2-4, 9-12	HDSP-4600	4	7	COMMON ANODE LH DECIMAL	E6006000
DS 1,7	HDSP-4606	0	2	UNIVERSAL OVERFLOW +-1	E6006000
DS 36-38	HDSP-4850	6	3	10 ELEMENT BAR GRAPH ARRAY	E6006000
DS 62,63	HLMP-2300	3	2	LIGHT BAR LEGEND	E6006000
DS 24	HLMP-2350	3	1	LIGHT BAR SINGLE (RED)	E6006000
DS 8, 13, 14, 29-34	HLMP-2500	5	8	LIGHT BAR SINGLE (GREEN)	E6006000
DS 27	HLMP-2800	8	1	LIGHT BAR DOUBLE	E6006000
DS 5, 6, 25, 26	HLMP-2820	2	4	LIGHT BAR QUAD	E6006000
DS 3, 8, 28, 35	HLMP-2855	3	4	LIGHT BAR	E6006000

Table 6-3. Replaceable Parts

POWER SUPPLY ASSEMBLY

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
A2					
A2	08508-60002	3	1	PSU ASSEMBLY	E6006000
A2S1	08508-60017	0	1	LINE SWITCH ASSEMBLY	E6006000
T1	08508-80001	5	1	TOROIDAL TRANSFORMER	E6006000

Table 6-3. Replaceable Parts

IF MEASUREMENT ASSEMBLY

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
A3					
A3	08508-60003	4	1	IF PCB ASSEMBLY	E6006000

Table 6-3. Replaceable Parts

SEARCH AND LOCK ASSEMBLY

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
A4					
A4	08508-60004	5	1	SEARCH AND LOCK ASSEMBLY	E6006000

Table 6-3. Replaceable Parts

PROCCESSOR ASSEMBLY

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
A5					
A5	08508-60005	6	1	PROCESSOR ASSEMBLY	E6006000
	08508-60105	7	1	PROCESSOR ASSEMBLY (WITHOUT EPROM)	E6006000
A5U18	08508-80012	5	1	EPROM ASSEMBLY	E6006000

Table 6-3. Replaceable Parts

MAIN CHASSIS/FRAME ASSEMBLY (Refer to Figure 6-2)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
1	08508-00001	6	1	FRONT PANEL DRESS	E6006000
2	08508-60002	3	1	SUB-PANEL FRONT	E6006000
3	5021-8403	4	1	FRONT FRAME	E6006000
4	00853-20068	9	1	SIDE FRAME - LEFT	E6006000
5	08508-00010	7	1	MAIN DECK - LEFT	E6006000
6	08508-00025	4	1	REAR PANEL	E6006000
7	00853-20067	8	1	REAR FRAME	E6006000
8	08508-00007	2	1	BRACKET - TRANSFORMER	E6006000
9	08508-00005	0	1	PLATE - PSU HEATSINK	E6006000
10	08508-00011	8	1	MAIN DECK - RIGHT	E6006000
11	00853-20070	3	1	SIDE FRAME - RIGHT	E6006000
12	08508-20102	0	1	WINDOW - MACHINED	E6006000

Table 6-3. Replaceable Parts

CABINET PARTS (Refer to Figure 6-1)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
1	5062-3811	4	1	SIDE COVER - RIGHT	E6006000
2	5040-7221	2	4	REAR FOOT	E6006000
3	5041-9434	5	1	TOP COVER	E6006000
4	5041-8802	9	1	TOP TRIM	E6006000
5	5062-3836	3	1	SIDE COVER - LEFT	E6006000
6	5021-9840	5	1	FRONT HANDLE - LEFT	E6006000
7	5041-9446	9	1	BOTTOM COVER	E6006000
8	5021-9840	5	1	FRONT HANDLE - RIGHT	E6006000
9	5040-7201	8	4	FOOT	E6006000
10	1460-1345	4	2	TILT STAND	E6006000
	5040-9805	2	1	STRAP HANDLE	E6006000
	5041-6019	6	1	SIDE STRAP COVER - FRONT	E6006000
	5041-6820	7	1	SIDE STRAP COVER - REAR	E6006000

Table 6-3. Replaceable Parts

MISCELLANEOUS PARTS

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
W1	08508-60011	4	1	CABLE A3 TO A5 DATA/CONTROL/POWER	E6006000
W2	08508-60011	4	1	CABLE A4 TO A5 DATA/CONTROL/POWER	E6006000
W3	08508-60013	6	1	CABLE A2 TO A5 POWER +5V, ±12V	E6006000
W4	8120-2587	6	1	CABLE A3 TO A4 A CHANNEL IF OUT	E6006000
W5	8120-2585	4	1	CABLE A3 TO A4	E6006000
W6	08508-60014	8	1	CABLE MAG OUT	E6006000
W7	08508-60014	8	1	CABLE PHASE OUT	E6006000
W8	08753-60045	1	1	CABLE A1 PROBE POWER	E6006000

Table 6-3. Replaceable Parts

OPTION 001. CABINET PARTS

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
	00853-00048	3	1	TOP COVER ASSEMBLY	E6006000
	00853-00049	4	1	BOTTOM COVER ASSEMBLY	E6006000
	00853-60050	0	1	FRONT PANEL COVER ASSEMBLY	E6006000
	00853-20068	9	2	SIDE FRAME	E6006000
	5001-0439	8	2	TRIM, SIDE FRONT	E6006000
	00853-40009	0	2	REAR FOOT	E6006000
	0515-0895	4	4	SCREW MACH M3.5x30mm LG PAN-HD-POZI	E6006000
	0515-1362	2	6	SCREW MACH M3.5x40mm LG PAN-HD-POZI	E6006000
	2190-0018	5	10	LOCK WASHER .141 ID	E6006000
	00853-40011	4	1	CARRY HANDLE ASSEMBLY	E6006000
	00853-40007	8	2	COLLAR, BEZEL	E6006000
	5020-8788	6	2	GEAR, RING HANDLE	E6006000
	5020-8733	1	2	GEAR, HUB HANDLE	E6006000
	1460-0604	7	2	SPRING, COMP	E6006000
	2190-0586	2	2	LOCK WASHER	E6006000
	0515-0982	0	2	SCREW-MACH M4x0.7 20mm-LG PAN-HD	E6006000
	2360-0121	2	4	SCREW-MACH 6-32 .5-in-LG PAN-HD-POZI	E6006000
	5041-2642	3	2	HUB TRIM CAP	E6006000

Table 6-3. Replaceable Parts

OPTION 001. MAIN CHASSIS/FRAME PARTS

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code
SAME AS THE STANDARD INSTRUMENT, EXCEPT FOR THE FOLLOWING PARTS:					
	00853-20068	9	1	SIDE FRAME, LEFT	E6006000

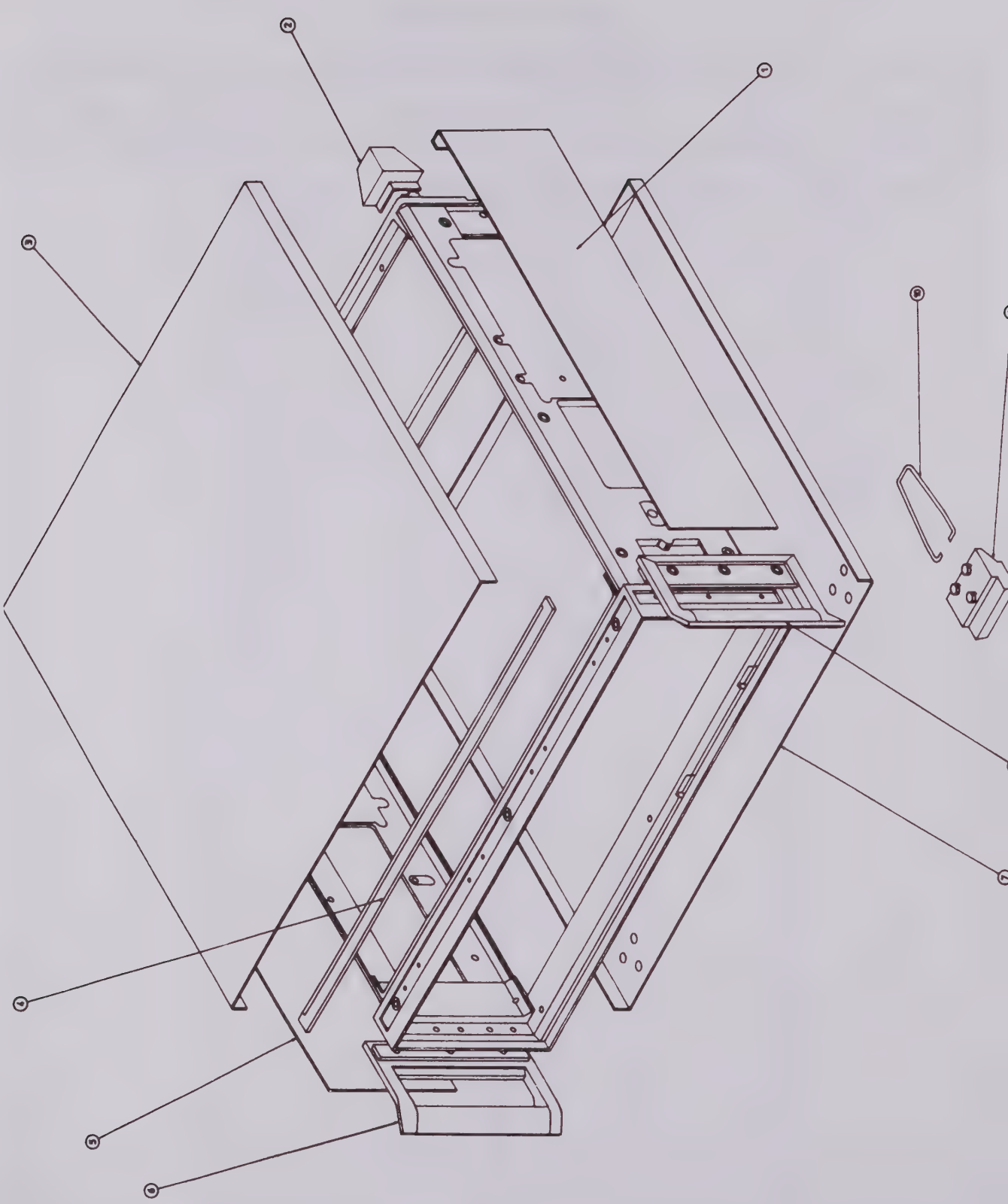

Figure 6-1. Cabinet Parts

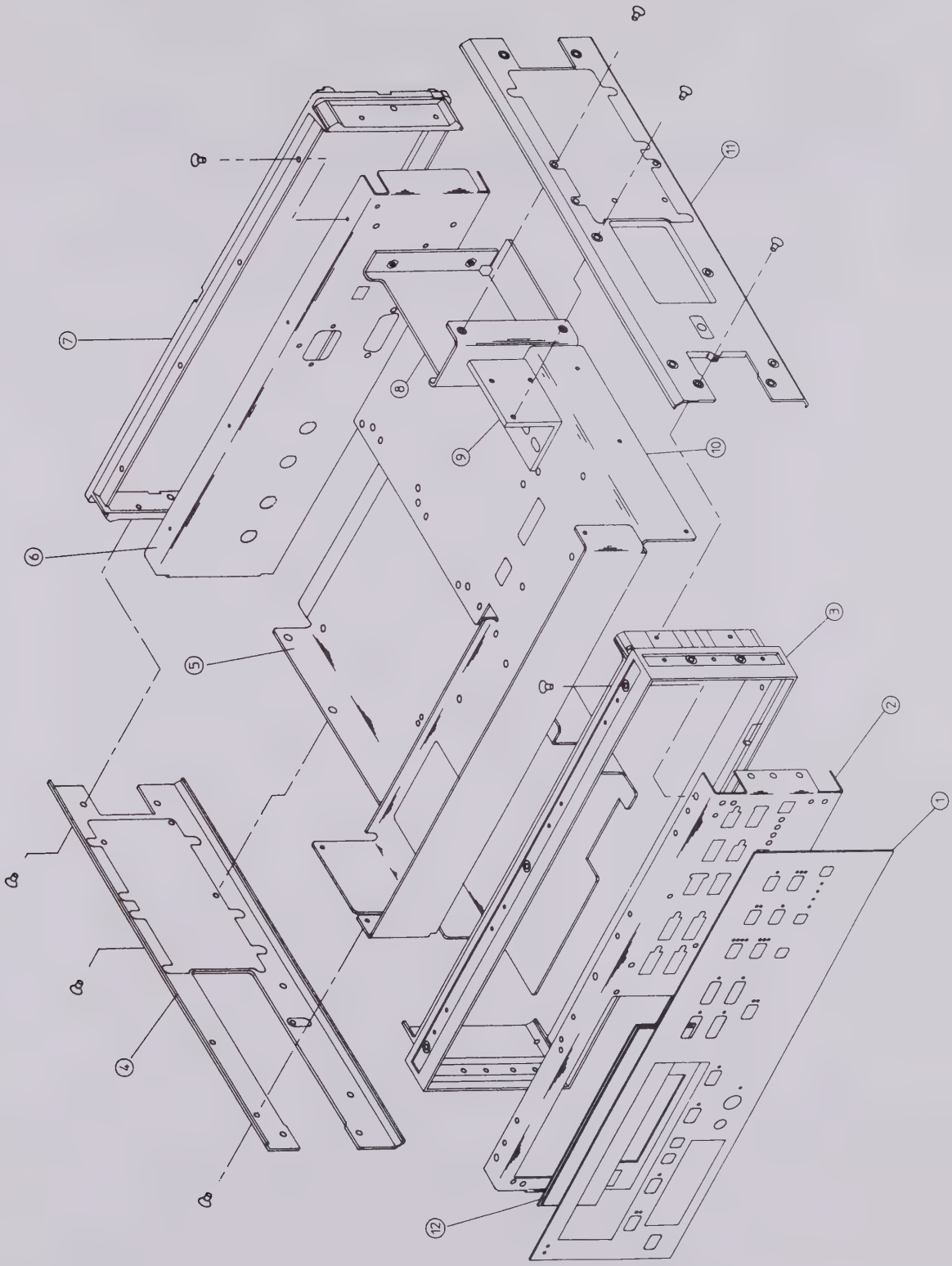

Figure 6-2. Mechanical Parts

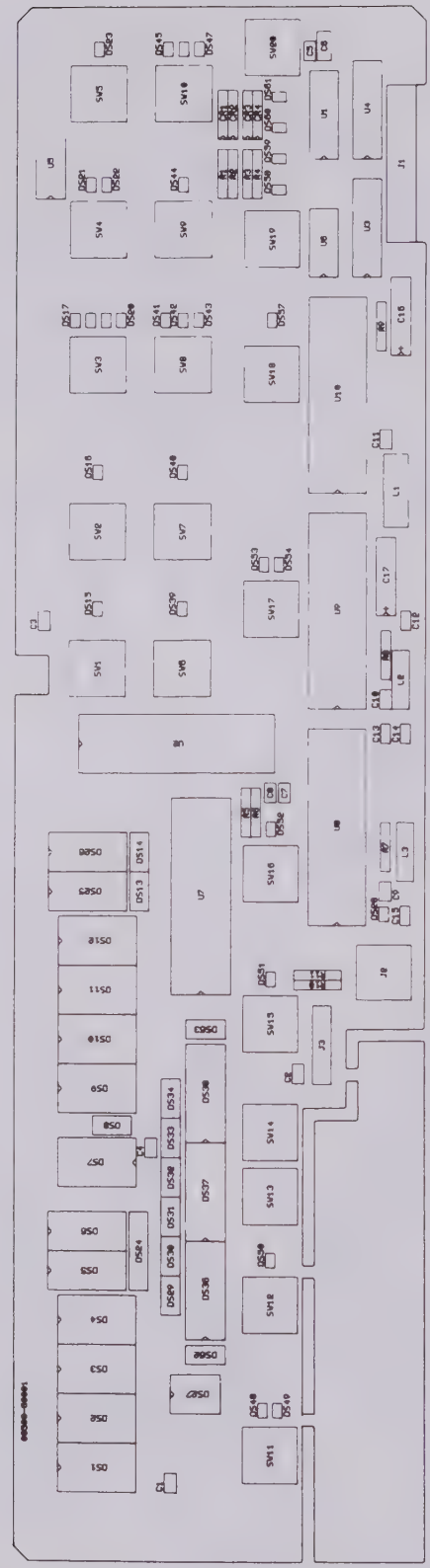

Figure 6-3. Front Panel/Keyboard Parts Locations

Manual Changes

Section 7

7-1 INTRODUCTION

Not applicable to this issue.

Service Section 8

8-1 INTRODUCTION

The service section contains all the information necessary to enable qualified service personnel to troubleshoot and repair the HP 8508A Vector Voltmeter.

8-2 SAFETY CONSIDERATIONS

Before applying power to the instrument or removing any of the covers, review the following warnings and cautions.

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY TRAINED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

TO PROTECT OPERATING PERSONNEL, THE INSTRUMENT CHASSIS AND CABINET MUST BE GROUNDED. THE INSTRUMENT IS EQUIPPED WITH A THREE-WIRE POWER CORD WHICH, WHEN PLUGGED INTO AN APPROPRIATE RECEPTACLE, GROUNDS THE INSTRUMENT. THE OFFSET PIN ON THE ON THE POWER PLUG IS THE GROUND CONNECTION. TO PRESERVE THIS PROTECTION FEATURE, THE POWER PLUG SHALL ONLY BE INSERTED IN A THREE-TERMINAL RECEPTACLE HAVING A PROTECTIVE EARTH GROUND CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD OR ADAPTER THAT DOES NOT HAVE THE REQUIRED EARTH GROUND CONNECTION. GROUNDING ONE CONDUCTOR OF A TWO-CONDUCTOR OUTLET IS NOT SUFFICIENT PROTECTION.

CAUTION

1. To prevent damage to the instrument power supply circuits, verify that the line voltage selection switch (located on the instrument rear panel) is set to the correct line voltage.

2. The HP 8508A and its Input Modules contain static sensitive devices which may be damaged as a result of static discharge.

3. To prevent equipment damage, do not disconnect circuit boards when the POWER switch is ON.

4. To avoid contamination of circuit board connectors, DO NOT HANDLE or TOUCH the connector pins.

8-3 AFTER SERVICE PRODUCT SAFETY CHECKS

Visually inspect the interior of the instrument for any signs of abnormal internally-generated heat (such as discoloured printed circuit boards or components, damaged insulations, or evidence of arcing). Determine and remedy the cause of any such conditions.

Using a suitable ohmmeter, check the resistance from instrument closure to ground pin on the power cord plug. The reading must be less than one ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist.

Check line fuse to verify that a correctly rated fuse is installed.

8-4 ANTI-STATIC PRECAUTIONS

All the printed circuit boards contained in this instrument have components and devices which are susceptible to damage by electro-static discharge (ESD). To minimize the risk of damaging or decreasing the reliability of the instrument, the following procedures and cautions should be observed when servicing the instrument.

Static-free workstation
All servicing should be carried out at a static free workstation.

De-soldering
When de-soldering components, ensure that the soldering iron is earthed. Always use a metalized solder remover.

Anti-static freezer spray
When attempting to locate a temperature related fault, use only an approved anti-static freezer spray.

8-5 RECOMMENDED TEST EQUIPMENT

Equipment required to troubleshoot the HP 8508A is listed in Table 1-2. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

8-6 TROUBLESHOOTING

General Description

The HP 8508A mainframe is a dual-channel IF processor that receives two 20 kHz IF signals from the Input Module and measures these to determine the Amplitude and Phase characteristics. The results of this measurement are presented on the Digital Display and are available at the HP-IB programming Interface. In addition, DC representations and real time outputs of of the Amplitude and Phase values are made available on the instrument rear panel. Instrument operation is under the control of a digital processor which also has built in routines to provide the data in a number of different formats.

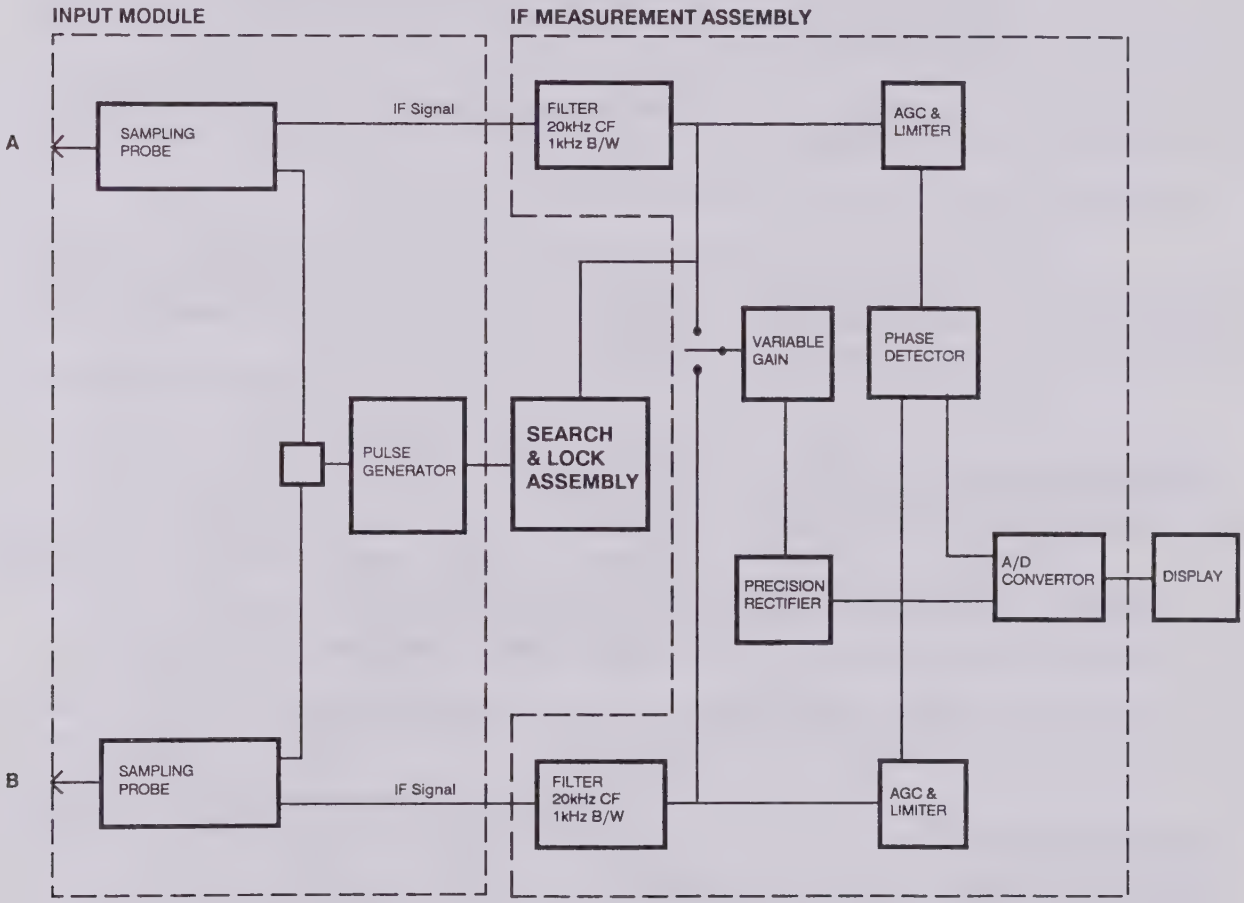

Figure 8-1. Simplified Block Diagram of the HP 8508A Vector Voltmeter System

Fault finding in the HP8508A is aided by the Self Test routine which is run whenever the instrument power is switched on. This routine checks the assemblies in the sequence shown in the following table. The current firmware revision will be shown in DISPLAY 2 for a few seconds. After this period, DISPLAY 1 will indicate 'tSt' while DISPLAY 2 will show a 3-digit series number appropriate to the assembly being tested. The whole test routine takes approximately 8 seconds to complete, with the A5 Processor Assembly occupying about 6 seconds of this time. Should an error be detected, the routine will halt with an error number in Display 2.

Designation	Assembly	Test Series Number
A5	Processor	500
A2	Power Supply	200
A4	Search and Lock	400
A3	IF Board	300

When a faulty assembly is detected, an error code in the series will appear in Display 2. However, before replacing the suspect assembly, a check should be made of the Power Supply Levels, cables and connections and any adjustments relative to the assembly. For example, an IF Assembly error may be caused by a damaged sampler; and, a Power Supply error may be caused by a faulty Search and Lock Assembly. Specific troubleshooting information is given by error code series in the following pages.

Following any replacement, perform any required adjustment procedure, then the full performance test to ensure that the instrument meets specifications.

For the adjustments, use tuning tool HP part number 8830-0024.

NOTE: Under some circumstances, it is possible that a 4-digit error code will be displayed (although this is not likely to happen during the normal test routine). Should this type of Error Code appear, the instrument power should be cycled and, if the error reappears, please contact your local HP Service Office.

Disassembly and Reassembly Procedure For the Standard Instrument

Top Cover Removal

To remove the top cover from the Vector Voltmeter, follow the procedure listed below:

a. Remove the two rear feet, each of which is held in place with a Pozidriv screw.

b. Undoing the Pozidriv screw at the centre of the rear edge of the Top Cover will cause the cover to slide back. When it is clear of the front frame it can then be lifted off.

Refitting the Top Cover

Refitting of the top cover is the reverse of this procedure.

Bottom Cover Removal

To remove the bottom cover of the Vector Voltmeter, follow the procedure listed below.

a. Place the Vector Voltmeter with the bottom cover facing up.

b. Remove the 2 rear feet, each of which are held in place with a Pozidriv screw.

c. Undoing the Pozidriv screw at the centre of the rear edge of the bottom cover will cause the cover to slide back. When it is clear of the front frame it can then be lifted off.

Refitting the Bottom Cover

Refitting of the bottom cover is the reverse of this procedure.

Disassembly and Reassembly Procedure For Option 001 Instruments

Top Cover Removal

To remove the top cover from the Vector Voltmeter, follow the procedure listed below:

a. Remove the 2 rear feet which are each held in place by 5 Pozidriv screws.

b. Separate the Carrying Handle from the top cover by first removing the snap-on plastic caps covering the handle hub assembly. Access can then be made to remove the single Pozidriv screw holding each hub to the side frame. By pulling the handle hubs outwards, the handle will then come away from the instrument.

c. Undoing the Pozidriv screw at the centre of the rear edge of the Top Cover will cause the cover to slide back. When it is clear of the front frame it can then be lifted off.

Refitting the Top Cover

Refitting of the top cover is the reverse of this procedure.

Bottom Cover Removal

To remove the bottom cover of the Vector Voltmeter, follow the procedure listed below.

a. Remove the 2 rear feet which are each held in place by 5 Pozidriv screws.

b. Place the Vector Voltmeter with the bottom cover facing up.

c. Undoing the Pozidriv screw at the centre of the rear edge of the bottom cover will cause the cover to slide back. When it is clear of the front frame it can then be lifted off.

Refitting the Bottom Cover

Refitting of the bottom cover is the reverse of this procedure.

FRONT PANEL ASSEMBLY A1

There are no error codes associated with this assembly. Malfunctions will be visual (for example, displays not working).

Summary Description

The Front Panel Assembly is the interface between the user and the instrument. The digital display shows the results of the system measurements and operating conditions are set up through the front panel keys.

Troubleshooting the Front Panel Assembly

The most likely problems with the front panel assembly are the LED's and switches. Tests controlled by the Processor Assembly will assist in addressing these problems.

These Tests are set by setting the test switch on the processor board and monitored by the front panel and the test LED's on the processor board. The following diagram shows the location of the switch and LED's.

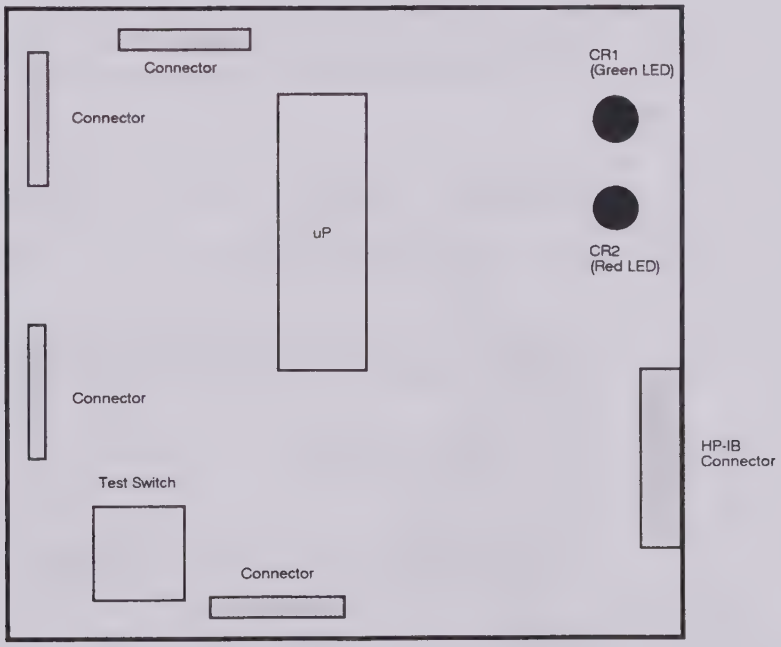

Figure 8-2. Processor Assembly Test Switch Location

NOTE: After selecting a test switch position, the HP 8508A power must be cycled. When the tests are completed, the test switch should be reset to the "0" position and the power cycled to restore normal operation.

Test	Switch Position	Procedure	Result
Key Switches	4	Press any key on the front panel	Green LED on the processor should flash and the number for the key pressed should appear in the display. Key numbers are shown in the table below. If the green LED does not flash and the display does not show the key number, the keyboard is suspect. If Green LED flashes but no Key No. is displayed, then Processor Assembly is suspect.
Display LED's	5	The display should come on in a cyclic manner.	If there is no Display, check the +5 volt supply to the Front Panel. If only part of the Display comes on, check the LEDs. Otherwise, replace the Front Panel Circuit Board.

NOTE: The LEDs forming the main part of the Front Panel Display are available as a set that has been matched for intensity level. Although the LEDs are available on an individual basis there can be no certainty that the replacement will match the installed LEDs in intensity. The preferred replacement Front Panel Assembly is HP part number 08508-60101. This assembly is supplied without the Display LED's installed thus permitting re-use of the LED's from the defective assembly.

Keycode	Description
1	A
2	B
3	REFL MEAS
4	FORMAT
5	POWER MEAS
6	B/A MAG
7	B-A PHASE
8	REF SELECT
9	REF
10	SYSTEM IMPD
11	METER SELECT
12	LOCK RANGE
13	STEP UP
14	STEP DOWN
15	MAG RANGE
16	HOLD VALUE
17	DISPLAY
18	SHIFT
19	LCL
20	PRESET

Disassembly and Replacement Procedures

Removal of Front Panel Assembly (A1)

a. Wear a wrist strap for ESD protection.

b. Remove the Input Module.

c. Remove the instrument top cover.

d. Remove trim from top and sides of the instrument Front Frame. A small flat-bladed screwdriver will usually be best for this operation.

e. Remove the 7 Pozidriv screws holding the Front Frame in position (see Figure 8-2).

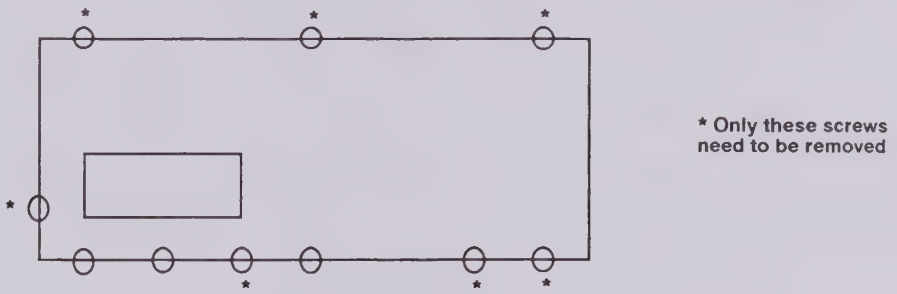

Figure 8-3. Front Panel Removal

On the Left Hand side of the frame there is 1 fixing screw. On the Top part of the frame there are 3 fixing screws. On the underside of the frame there are 3 fixing screws.

NOTE: There are additional screws holding the Module tray and the Left Hand Main Deck. These screws do not need to be removed.

f. The Front Panel Assembly can then be withdrawn from the instrument, taking care not to damage the ribbon cable connecting the Front Panel assembly to the Processor card.

Refitting the Front Panel Assembly

Refitting the Front Panel Assembly is the reverse of the above procedure.

To Gain access to the component side of the Front Panel Assembly

a. Remove the Front Panel Assembly from the instrument as mentioned previously.

b. Remove the 9/16 nut and washer securing the TEST OUT connector to the front panel.

c. Remove the 9 Pozidriv fixing screws that hold the circuit board in position on the front panel metalwork.

d. Carefully lift out the front panel circuit board and disconnect the Probe Power connector so that the assembly may be lifted free.

Refitting the Front Panel assembly is the reverse of the above procedure.

ERROR CODES 200 SERIES

Errors in this series indicate a problem with the Power Supply Assembly.

POWER SUPPLY ASSEMBLY A2

Summary Description

The power supply is a conventional linear circuit design that provides the instrument with supplies of +5 Volts and ±12 Volts. Test Points and adjustments are provided on the Circuit Board.

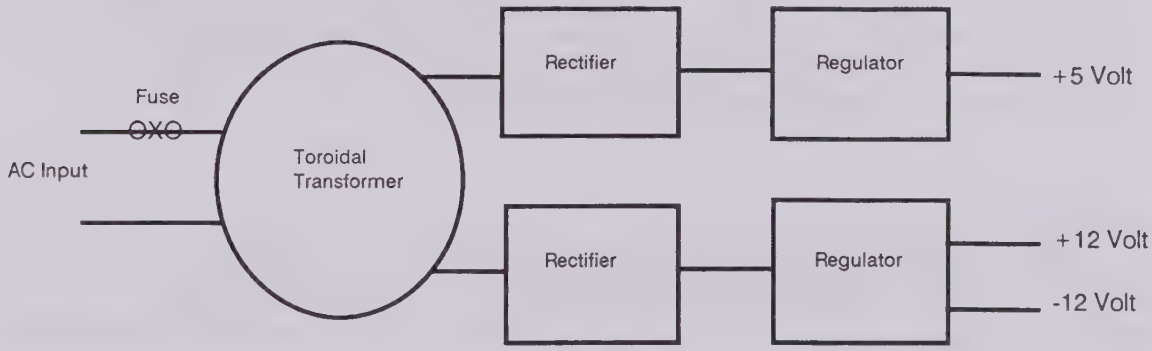

Figure 8-4. Simplifed Block Diagram of the Power Supply

Troubleshooting

A fault in the power supply will be indicated by a display of an Error Code in the 200 series and, if this should arise, the transformer, supply voltages and distribution cables should be checked and any faulty items replaced. Because the ±12V check is performed using the Search and Lock Assembly (A4), a fault on the Search and Lock Assembly (A4) can indicate an error on the Power Supply Assembly (A2). Should the Error Code persist the defective assembly should be replaced with a new one.

Disassembly and Reassembly Procedures

Removing the Power Supply Assembly

To remove the Power Supply Assembly from the Vector Voltmeter:

a. Wear a wrist strap for ESD protection.

b. Remove the power cord from the instrument.

c. Remove the instrument top cover.

d. Remove the nut and washer securing the power connector Earth lead to the rear panel.

e. Remove the 2 Nuts and Pozidriv screws securing the power connector to the rear panel.

f. Remove the 3 Cable connections to the Power Supply board.

g. Remove the 3 Pozidriv screws securing the Heatsink to the sideframe.

h. Remove the plastic safety cover after undoing the 4 Pozidrive holding screws.

i. Remove the 2 Pozidrive locating screws on the mains switch.

j. Remove the 7 Posidrive screws securing the Power Supply board to the main deck.

k. The Power Supply board can now be tilted up on the left side and the mains swich unsoldered and removed.

NOTE: Do NOT dismantle the switch assembly and take care not to bend the operating cable.

l. The Power Supply board can now be removed from the instrument.

Refitting the Power Supply Assembly

Refitting the Power Supply is the reverse of the above procedure.

NOTE: After installing a new Power Supply assembly, the HP 8508A Adjustment procedures and Performance Tests should be performed.

ERROR CODES 300 SERIES

Errors in this series indicate a problem in the A3 IF Assembly.

IF ASSEMBLY A3

Summary Description

The two 20 kHz IF signals produced by the RF Input Module, are passed to the IF Assembly which operates under Processor control. The IF assembly measures the amplitude of these two signals and the phase difference (B-A) between them. The results of this measurement are expressed as DC voltages, which are digitised by the on board A-D Convertor, for further manipulation by the Processor (A5).

The IF Assembly also provides real time outputs for the Amplitude and Phase values.

Troubleshooting the A3 IF Assembly

A fault in the IF Assembly will be indicated by an Error Code display in the 300 series. Check that the assembly and all cable connections are securely in place and also that there are no obvious defects. An IF Assembly error report may be caused by a damaged sampler. Carry out the appropriate adjustments for the IF Assembly, if necessary replace the sampler assemblies and re-run the Self Test procedure. Should the Error Code persist, the IF Assembly should be replaced with a new one.

Disassembly and Reassembly Procedures

Removing the IF Assembly

To remove the IF Assembly from the Vector Voltmeter:

a. Wear a wrist strap for ESD protection.

b. Remove the Input Module from the instrument.

c. Remove the instrument top cover.

d. Disconnect the cable connections from the IF Assembly.

e. Remove the 10 Pozidriv screws that secure the IF circuit board to the main deck.

f. The IF Assembly can now be removed from the instrument.

Refitting the IF Assembly

Refitting is the reverse of this procedure. Note the cable connections detailed in the diagram below.

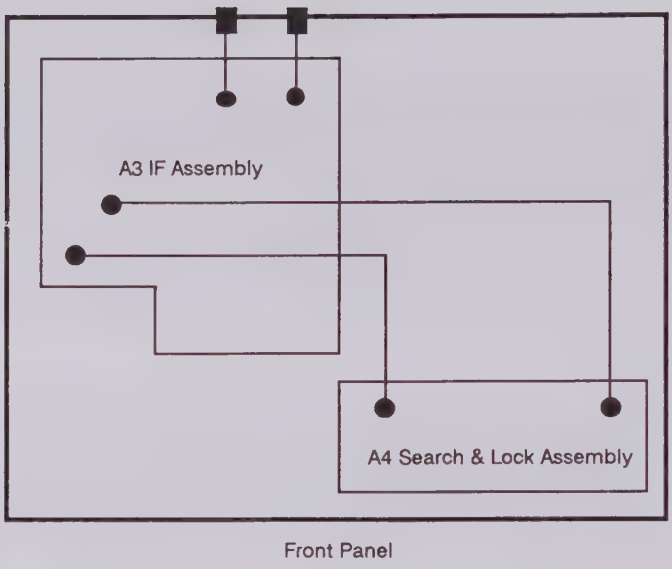

Figure 8-5. IF and Search and Lock Interconnections

ERROR CODES 400 SERIES

Error Codes in this series indicate a problem with the Search and Lock Assembly

SEARCH and LOCK ASSEMBLY A4

Summary Description

The function of the Search and Lock assembly is to provide an optimally selected frequency to the Sampling Pulse Generator in the Input Module. This frequency is generated by a VCO.

The assembly operates in one of two modes. In the SEARCH mode, the VCO is swept and the output of the Sampling Gate monitored until a suitable response is found. At this point the processor switches the board into the LOCK mode where the VCO is tuned to phase lock the IF to the 20 kHz reference. When this has been accomplished the system is able to make measurements.

Troubleshooting the Search and Lock Assembly

A fault in the Search and Lock Assembly will be indicated by an Error Code display in the 400 series. If this should occur, the assembly and all connections should be checked for integrity. The adjustment procedures for the assembly should be carried out and the system Self Test procedure re-run. If the assembly still proves faulty, it should be replaced with a new one.

Disassembly and Reassembly Procedures

Removing the Search and Lock Assembly

To Remove the Search and Lock Assembly from the Vector Voltmeter:

a. Wear a wrist strap for ESD protection.

b. Remove the instrument top cover.

c. Disconnect the cable connections from the Search and Lock Assembly.

d. Remove the 8 Pozidriv screws that secure the Search and Lock Assembly to the main deck.

e. The Search and Lock Assembly can now be removed from the Instrument.

Refitting the Search and Lock Assembly

Refitting is the reverse of this procedure. Note the cable connections detailed in the diagram below.

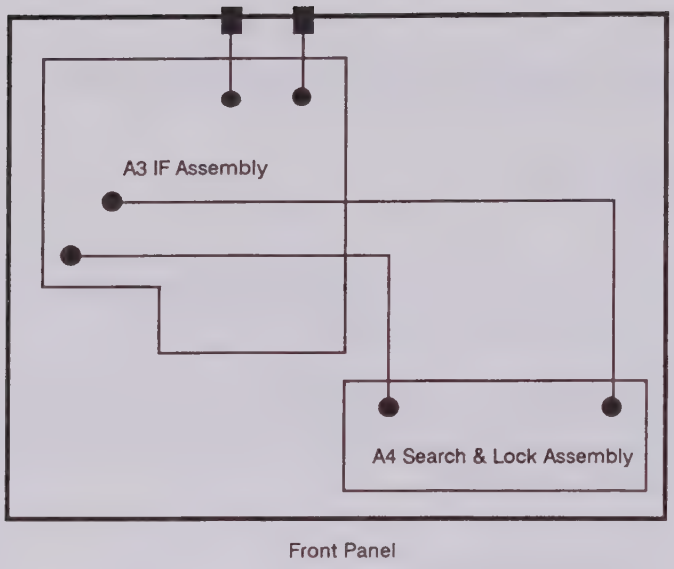

Figure 8-6. IF and Search and Lock Interconnections

ERROR CODES 500 SERIES

Errors in this series indicate a problem in the A5 Processor Assembly.

PROCESSOR ASSEMBLY A5

Summary Description

The Processor controls the operation of the instrument.

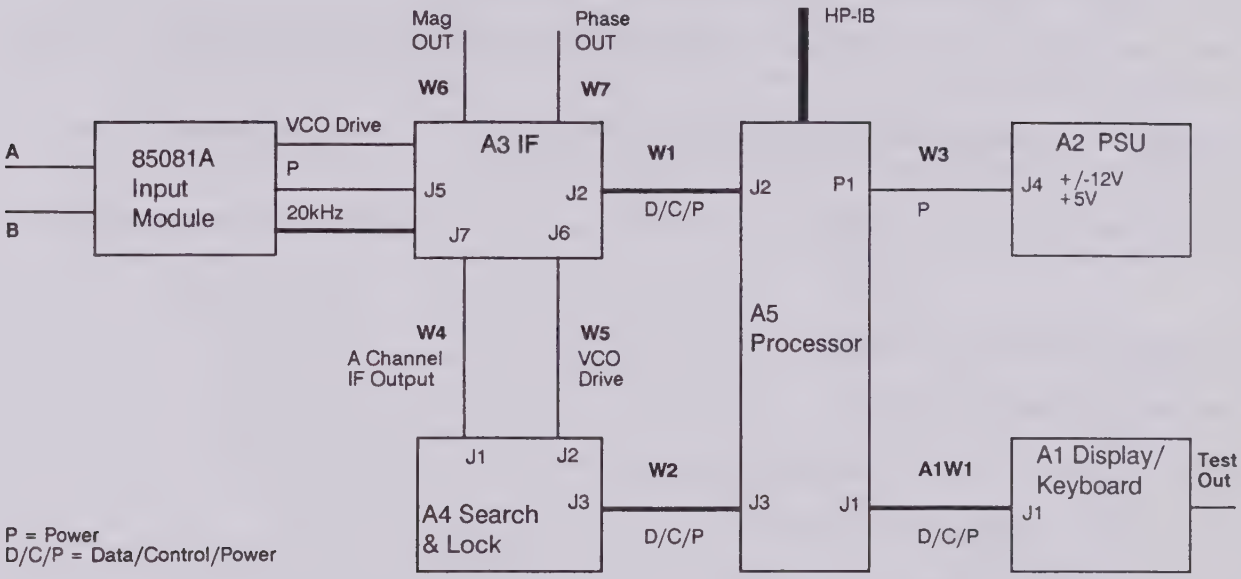

Figure 8-7. HP 8508A Physical Configuration

Troubleshooting the A5 Processor Assembly

The Processor Assembly is checked during the Self Test routine, and any failure will result in a 500 series Error Code being displayed. If this should occur, check that the assembly, all cable connections and socketed components are securely located. Re-run the self test.

In the event of a Processor Assembly failure, it is possible to repair the fault by replacing either the ROM only, or by substituting a new processor assembly that utilizes the current ROM. The following procedure performs additional tests that will indicate if the ROM is in fact operating correctly.

Error Code 500 indicates a ROM test failure. In this case a further ROM test is available as follows.

1. Power the HP 8508A off.
2. Select Position 1 of the test switch on the Processor assembly.
3. Power the HP 8508A on. Both the red and green LED's should come on and then both should rapidly extinguish. If after approximately 6 seconds, the green LED should come on again and stay on, the ROM test has been successful. If, however, the red LED should come on, the test has failed and the ROM (A5U18) should be replaced.
4. Switch the instrument off and replace the ROM.
5. Repeat the ROM test as in steps 2 and 3.
6. If the test should still not be successful, replace the A5 Assembly.

Should another Error Code in the 500 series appear, the Processor assembly should be replaced with a new one. In this case the ROM has passed its self test and can be re-used.

Note that a replacement Processor Assembly can be ordered either with or without a ROM installed. The part numbers for both assemblies are given in Section 6 of this manual.

Reset the test switch to the "0" position and cycle the power to reset the processor to its normal operating mode.

Disassembly and Reassembly Procedures

Removing the Processor Assembly

To remove the Processor Assembly from the Vector Voltmeter:

a. Wear a wrist strap for ESD protection.

b. Remove the instrument Bottom Cover.

c. Disconnect the cable connections to the assembly.

d. Remove the 2 screws securing the HP-IB connector to the rear panel.

e. Remove the 6 screws securing the Processor Assembly to the Instrument deck.

f. The Processor Assembly may now be removed from the instrument.

Refitting the Processor Assembly

Refitting is the reverse of this procedure.

ERROR CODES 600 SERIES

Errors in this series indicate a problem in the Input Module. Refer to the appropriate Input Module Service Manual for troubleshooting details.

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